JPRS-USP-87-005
19 AUGUST 1987

296102

FOREIGN BROADCAST INFORMATION SERVICE

JPRS Report

Science & Technology

USSR: Space

JPRS-USP-87-005

19 AUGUST 1987

SCIENCE & TECHNOLOGY

USSR: SPACE

CONTENTS

SPACE SCIENCES

COSMONAUTS BEGIN 15TH WEEK IN ORBIT

Moscow IZVESTIYA in Russian 16 May 87 p 1

[TASS Report]

[Text] Flight Control Center, 15 May. Yuriy Romanenko and Aleksandr Laveykin have begun the 15th week of their space mission.

The flight program in the days just past has included work on activating the "Kvant" module and checking its scientific instruments and their functioning, photographing of individual regions of the territory of the Soviet Union, and medical examinations.

The cosmonauts have tested the operation of the module's "Elektron" apparatus, which is one of the elements of a system for maintaining the gas composition of the atmosphere of the manned complex; it is intended for producing oxygen by the method of electrolysis of water.

Today the crew is continuing to prepare the astrophysical module for scientific research. Also planned are technical experiments and routine maintenance of onboard systems.

Tomorrow will be a day of rest for the crew. They will visit with their families during sessions of radio and television communications.

Both cosmonauts are feeling well.

The flight of the manned complex "Mir" is proceeding normally.

FTD/SNAP
/8309
CSO: 1866/110

OBSERVATION PLANS FOR 'GLAZAR' TELESCOPE ON 'KVANT' MODULE

Moscow PRAVDA in Russian 20 May 87 p 8

[Text] As is known, Yuriy Romanenko and Aleksandr Laveykin are to carry out a program called "Glazar" on board the astrophysical module "Kvant," in addition to other studies. Our correspondent Yu. Arakelyan asked Professor G. Tovmasyan, scientific director of this experiment, to tell about the program.

"The telescope 'Glazar' was developed by scientists of the Byurakan Astrophysical Observatory and by industrial enterprises of Armenia, with the participation of Swiss astronomers. It is intended for studying the activity of nuclei of galaxies and quasars, the phenomenon of which was discovered by academician V. Ambartsumyan. Their processes are accompanied by powerful bursts and intense radio-frequency radiation. Excess ultraviolet radiation of the nuclei of galaxies and quasars is another manifestation of this activity.

"We can observe only a small, long-wave portion of this radiation from the Earth's surface, however, since most of the radiation is absorbed by our atmosphere and does not reach observers on the ground. For an observer in orbit, however, the thick curtain of the atmosphere is 'parted,' so to speak, and whole new space horizons open up. The task of the 'Glazar' is thus to scan the sky in the short-wave and vacuum ultraviolet regions, so that galaxies and quasars with excess ultraviolet radiation can be sought and discovered, and a 'census' of these objects ultimately made. Ultraviolet radiation of objects that are already known will be studied at the same time."

"How will observations be recorded?"

"The telescope's main mirror is 40 centimeters in diameter. It is not a large instrument by terrestrial standards. Together with an electronic amplifier, however, the telescope will make it possible to obtain images of celestial objects which are almost a million times fainter than those which can be observed by the unaided eye. Photographs of sections of the sky that are observed will be made on film, which will be brought to Earth by cosmonauts returning from 'Mir." Fresh packs of film will be delivered regularly to orbit."

"How will the observations be conducted?"

"The telescope and the whole station together will first be aimed 'roughly' at an area that is under study. The telescope's automation equipment will then go into operation: star sensors will fix on the brightest star in the area under observation, and the telescope will be kept aimed in the prescribed direction with sufficiently high precision while photographing is in progress. This is a rather complex task. After all, observations are made from a station that is flying around the Earth, and the direction of the telescope's axis must be maintained with a precision of about two seconds of arc."

"How long will the 'Glazar' operate in orbit?"

"For the entire program to be carried out, several tens of thousands of pictures will have to be obtained. From all appearances, this will take several years."

FTD/SNAP
/8309
CSO: 1866/110

'PROGRESS-30' CARGO SHIP LAUNCHED

Riga SOVETSKAYA LATVIYA in Russian 21 May 87 p 1

[Text] In line with the program of further work on board the orbiting scientific research complex "Mir," an unmanned cargo spaceship, "Progress-30," was launched from the Soviet Union on 19 May 1987, at 0802 hours Moscow time.

The purpose of the launching of the spaceship is to deliver materials which become depleted and various cargo items to the manned complex "Mir."

The "Progress-30" ship was placed into an orbit with the parameters: maximum distance from the surface of Earth--265 kilometers; minimum distance from the surface of Earth--192 kilometers; period of revolution--88.8 minutes; inclination--51.6 degrees.

According to telemetry information, the onboard systems of the unmanned cargo ship are functioning normally.

FTD/SNAP
/8309
CSO: 1866/110

'PROGRESS-30' DOCKS WITH 'MIR' COMPLEX

Moscow PRAVDA in Russian 22 May 87 p 1

[Text] The cargo spaceship "Progress-30" docked with the manned complex "Mir" on 21 May 1987 at 0953 hours Moscow time.

The mutual search, rendezvousing, approach and docking were carried out with the aid of onboard automation. These procedures were monitored by the Flight Control Center interacting with the ground command-and-measurement complex, and also by cosmonauts Romanenko and Laveykin.

The "Progress-30" ship docked with the complex at the end where the "Kvant" module is located. Fuel for the station's combined engine unit, foodstuffs, water, equipment and instruments, and also mail were delivered into orbit.

According to telemetry data and the crew's reports, the onboard systems of the "Mir" manned complex are functioning normally.

Yuriy Romanenko and Aleksandr Laveykin are feeling well.

FTD/SNAP
/8309
CSO: 1866/110

COSMONAUTS PERFORM EXPERIMENTS WITH DEPOSITION OF METAL COATINGS

Moscow IZVESTIYA in Russian 23 May 87 p 1

[TASS Report]

[Text] Flight Control Center, 22 May. The prolonged orbital flight of Yuriy Romanenko and Aleksandr Laveykin is continuing.

During the past week the cosmonauts worked on technical maintenance of onboard systems of the station and the astrophysical module, performed several series of observations and photography of the Earth's surface, and underwent a comprehensive medical examination.

In line with the program of space materials science studies, the crew performed a number of experiments for the further perfecting of the technology of applying metal coatings in conditions of space vacuum and weightlessness by the method of electron-beam vaporization and subsequent condensation. They sprayed several layers of a copper coating on a polymer film.

For the purpose of obtaining information on features of vaporization of multiple-component materials in zero gravity, an experiment was performed with vaporization of a copper-silver alloy.

Today's schedule calls for Yuriy Romanenko and Aleksandr Laveykin to carry out another series of geophysical studies, and also for unloading the "Progress-30" ship.

According to telemetry data and the crew's reports, the flight of the manned orbiting complex "Mir" is proceeding normally.

FTD/SNAP
/8309
CSO: 1866/110

CREW PRACTICES ORIENTATION WITH 'KVANT' GYROSCOPE STABILIZERS

Moscow IZVESTIYA in Russian 27 May 87 p 1

[TASS Report]

[Text] Flight Control Center, 26 May. The space mission of Yuriy Romanenko and Aleksandr Laveykin on board the manned orbiting complex "Mir" is continuing.

The crew's program of work today calls for unloading the unmanned transport ship "Progress-30," geophysical studies, and routine preventive maintenance of individual systems of the station.

In line with the program for study of Earth's natural resources and environment, the cosmonauts are conducting a series of experiments for the purpose of obtaining photographic information on various objects in nature in narrow spectral bands.

The cosmonauts are continuing work on perfecting methods of controlling the movement of the orbiting complex with the aid of gyroscopic power stabilizers installed on the module "Kvant." These stabilizers make possible orientation and stabilization of the complex with substantial savings of the fuel of the combined engine unit.

According to telemetry data and the crew's reports, the flight is proceeding normally.

Yuriy Romanenko and Aleksandr Laveykin are feeling well.

FTD/SNAP
/8309
CSO: 1866/110

COSMONAUTS CONTINUE WORK WITH GYRO STABILIZERS, BEGIN BIOLOGICAL EXPERIMENTS

Moscow IZVESTIYA in Russian 3 Jun 87 p 2

[TASS Report]

[Text] Flight Control Center, 2 June. The working day today on board the manned complex "Mir" began at 0900 hours Moscow time, and it will last until midnight.

In the morning, in line with the program of medical monitoring, Yuriy Romenenko and Aleksandr Laveykin measured their weight and made an evaluation of the condition of muscles that are not exerted much in zero gravity.

Today the crew will continue to practice methods of controlling the orbiting complex with the aid of power gyroscopic stabilizers and a high-precision astrotracker. During the day the cosmonauts will also do preventive-maintenance work on equipment of the life-support system.

In line with the program of biological research, experiments have been started in units called "Fiton" and "Rost." The purpose of these experiments is to continue studies of the development of higher-order plants and of various biological specimens in conditions of space flight.

According to the crew's reports and telemetry data, the work in near-Earth orbit is proceeding according to the designated program.

FTD/SNAP
/8309
CSO: 1866/110

COSMONAUTS INSTALL MULTIZONAL SPECTROMETER AND PHOTOMETER

Moscow IZVESTIYA in Russian 6 Jun 87 p 1

[TASS Report]

[Text] Flight Control Center, 5 June. The fourth month of the space flight of Yuriy Romanenko and Aleksandr Laveykin is coming to an end.

In the days just past the crew of the "Mir" manned complex did work on installing additional scientific instruments on the station, as well as preparing equipment for upcoming work and performing technical experiments.

In particular, the cosmonauts installed two more instruments and prepared them for work. One of them is a multizonal spectrometer which is intended for taking pictures of Earth's surface. The other is an electronic photometer which will be used in conducting astrophysical experiments.

Today the cosmonauts are continuing tests of the new system for controlling the complex by means of power gyroscopic stabilizers, and they are performing operations for technical maintenance of onboard equipment.

According to data of trajectory measurements, the orbit parameters of the manned complex are: maximum distance from Earth's surface--383 kilometers; minimum distance from Earth's surface--345 kilometers; period of revolution--91.6 degrees; inclination--51.6 degrees.

The work in near-Earth orbit is proceeding according to program. Yuriy Romanenko and Aleksandr Laveykin are feeling well.

FTD/SNAP
/8309
CSO: 1866/110

COSMONAUTS BEGIN PREPARATIONS FOR EVA

Moscow IZVESTIYA in Russian 10 Jun 87 p 1

[TASS Report]

[Text] Flight Control Center, 9 June. The long space mission of Yuriy Romanenko and Aleksandr Laveykin is continuing.

The first experiment has been performed in line with the program of astrophysical research using the orbiting international observatory "Rentgen," which is installed on the "Kvant" module. The supernova which flared up in the Greater Magellanic Cloud in February of this year was selected as the object of observation.

The cosmonauts have begun preparing for an egress into open space. They are checking equipment and space suits which are needed for this. A medical examination of the crew will be made at the end of working hours today. The purpose of this examination will be to evaluate the condition of the cardiovascular systems of the cosmonauts as they perform physical exercises.

Yuriy Romanenko and Aleksandr Laveykin are feeling well.

The flight of the orbiting scientific research complex "Mir" is proceeding normally.

FTD/SNAP
/8309
CSO: 1866/110

COMMENTARY ON INSTALLATION OF THIRD SOLAR PANEL ON 'MIR'

Moscow SOVETSKAYA ROSSIYA in Russian 13 Jun 87 p 1

[Article by V. Ovcharov, special correspondent at the Flight Control Center]

[Excerpt] Thanks to installation work that Yuriy Romanenko and Aleksandr Laveykin have begun in open space, the orbiting station "Mir" will acquire a third solar battery. This work is aimed at increasing the capability of the complex's power supply systems, for the purpose of conducting various scientific experiments.

"'Taymyrs', permission granted to open the exit hatch!"

These words were heard at the Flight Control Center on 12 June at about 2100 hours Moscow time.

Unlike "Salyut-7," the "Mir" station has not three but two solar batteries, which unfold like wings after the spacecraft has gone into orbit. They are located on the right and left sides of the station, in a horizontal plane.

The adding of solar batteries to a station was begun in 1983, by Vladimir Lyakhov and Aleksandr Aleksandrov on the "Salyut-7" station. One interesting side note is that the two space walks that they made then were directed from Earth by Yuriy Romanenko. And now it was his voice we were hearing from space:

"We're starting to work!"

We might recall that batteries that are added are usually folded up accordion-fashion and packed in containers for delivery to orbiting stations. A crew's work used to amount to carrying this package through the station's hatch compartment and out to the regular fixed battery that it was to be attached to, joining the extra battery to this battery and unfolding its panels with the aid of a winch. This time, the whole procedure is somewhat different. The solar battery that was delivered to "Mir" is a collapsible structure with two tiers. Each tier consists of a hinged lattice girder with two panels of photocells on its sides. Today, the crew of the "Mir" had to install the lower girder in the proper place and fasten the two panels of the first tier to it. In a few days, the crew will make another egress, during which they will install the second tier and open up all four panels of the solar battery.

FTD/SNAP
/8309
CSO: 1866/110

OBSERVATIONS WITH 'KVANT' X-RAY TELESCOPES, FINAL PREPARATIONS FOR EVA

Moscow IZVESTIYA in Russian 13 Jun 87 p 3

[TASS Report]

[Text] Flight Control Center, 12 June. The space mission of Yuriy Romanenko and Aleksandr Laveykin on board the "Mir" manned complex is continuing.

On 10 and 11 June, another series of astrophysical experiments was carried out with the aid of the international orbiting observatory "Rentgen." X-ray telescopes installed in the "Kvant" specialized module were aimed at the supernova in the Greater Magellanic Cloud, and at a neutron star in the constellation Cygnus.

Power gyroscopic stabilizers, which have become part of the overall system for controlling the movement of the complex, are making it possible to maintain high-precision orientation and stabilization of the complex over long periods of time, which is essential for conducting such experiments.

Today the cosmonauts will perform final operations to prepare equipment and apparatus that will be needed for work on the outer surface of the station. The crew's space walk will begin late in the evening.

Yuriy Romanenko and Aleksandr Laveykin are feeling well.

The flight is proceeding normally.

FTD/SNAP
/8309
CSO: 1866/110

COSMONAUTS COMPLETE FIRST PHASE OF SOLAR PANEL INSTALLATION

Moscow IZVESTIYA in Russian 14 Jun 87 p 1

[TASS Report]

[Text] Flight Control Center, 12 June. Cosmonauts Yuriy Romanenko and Aleksandr Laveykin have made an egress into open space and performed the first stage of work to install a third solar battery on the base block of the orbiting complex "Mir." It is intended for increasing the capacity of the power supply system; its installation during the period of flight of the complex was planned earlier.

The solar battery was delivered into orbit in the "Kvant" module. Structurally it consists of two assemblies, each of which includes an extendable girder and two sections of photoelectric converters.

The work in open space began at 2055 hours Moscow time on 12 June. After opening the hatch of the adapter module, the cosmonauts took components of the solar battery's first assembly, which were folded up, from inside the station and carried them to the work area.

On the outer surface of the complex's base block, the crew installed an extendable girder on a special mounting device, and then attached both sections of the photoelectric converters on the girder.

After completing these operations, the cosmonauts went back inside the orbiting complex. The time that Yuriy Romanenko and Aleksandr Laveykin spent in open space was one hour and fifty-three minutes.

The crew will make another egress into open space to install the second solar battery assembly, and then deploy it.

According to telemetry data and the reports from orbit, the onboard systems of the "Mir" manned complex are functioning normally.

Both cosmonauts are feeling well.

FTD/SNAP
/8309
CSO: 1866/110

COSMONAUTS COMPLETE SECOND EVA TO INSTALL SOLAR BATTERY

Moscow PRAVDA in Russian 18 Jun 87 p 1

[TASS Report]

[Text] Flight Control Center, 17 June. Cosmonauts Yuriy Romanenko and Aleksandr Laveykin have made another egress into open space and completed the installation of a new solar battery on the base block of the "Mir" complex.

As was reported earlier, during an egress on 12 June the crew had completed the first phase of work on installing the solar battery.

On 16 June at 1930 hours Moscow time, the cosmonauts again went out into open space to continue the work. They carried components of the solar battery's second assembly to the outer surface of the station. The crew attached the end of the extendable girder of this assembly to the assembly that had been installed earlier. Then they attached two sections of photoelectric converters to it.

After hooking up the electrical connections of all of the solar battery's sections, the cosmonauts unfolded it to its full length of 10.6 meters, using special mechanisms. The total effective area of the new solar battery is 22 square meters.

During their extravehicular activity, the crew affixed cassettes containing specimens of various structural and heat-shielding materials to the station's outer surface, for the purpose of continuing studies of the effects of factors of the space environment on these materials.

After completing all planned operations, Yuriy Romanenko and Aleksandr Laveykin returned inside the station. The time that comrades Romanenko and Laveykin spent in open space was 3 hours and 15 minutes. The cosmonauts are feeling well.

The next work will involve switching of electrical circuits inside the base block, and hooking-up the solar battery that was installed by the cosmonauts to the "Mir" complex's unified electrical system.

All of the planned operations in open space were carried out by the crew in close communication with specialists of the Flight Control Center and of design organizations. The cosmonauts demonstrated a high level of professional training and skill.

Increasing the capacity of the onboard power supply system will help to increase the effectiveness of scientific research work on the "Mir" complex substantially.

The successful completion of the planned installation work in open space represents a new stage in the perfecting of technological methods of creating in orbit large structures which will become key elements of future manned complexes for scientific and economic purposes.

(A photograph is given showing the cosmonauts at work outside the station.)

FTD/SNAP
/8309
CSO: 1866/110

NEW SOLAR PANEL BOOSTS 'MIR' POWER BY 2.4 KILOWATTS

Moscow GUDOK in Russian 16 Jun 87 p 4

[Article by B. Kuznetsov]

[Excerpt] An orbiting space 'train' with four 'cars' is gliding smoothly around the Earth. Four spacecraft with an overall length of nearly 35 meters are linked as if by one harness. Secured tightly to one another, they form a single complex that weighs about 50 tons. The inhabitants of this celestial residence have plenty of room to move around: the interior space of their airtight quarters is nearly 150 cubic meters.

Here is one interesting fact: in order to move from the re-entry vehicle of the "Soyuz" ship to the cargo compartment of the "Progress-30" ship, the crew must pass through nine hatchway doors.

The solar electric station of the "Mir" supplies power to all four spacecraft. The greenish square panes covering its solar battery panels convert sunlight into electricity. Although the capacity of the "Mir" solar electric station is considerably higher than the one on the [previous] "Salyut-7," the power demand is becoming greater and greater, considering that the complex's base block now has an astrophysical module and the "Progress-30" cargo ship attached to it. The capacity of the twin solar batteries of the "Mir" is 9 kilowatts, but the power demand from them has increased due to devices for orientation and stabilization of the complex, and other additional units. What is to be done in view of this?

Designers made plans beforehand for boosting the capacity of the "Mir" solar electric station by means of installing an extra (third) solar battery. When the "Kvant" astrophysical module docked with the base block, it had in one of its compartments a battery folded up into containers together with hardware for installing it. When fully deployed (the crew would have to make two space walks to accomplish this), this battery with an effective area of 24 square meters is capable of increasing the capacity of the "Mir" solar electric station by 2.4 kilowatts. The area of the twin solar batteries' panels is 76 square meters.

FTD/SNAP
/8309
CSO: 1866/110

COSMONAUTS COMPLETE 19 WEEKS IN ORBIT

Moscow IZVESTIYA in Russian 20 Jun 87 p 1

[TASS Report]

[Text] Flight Control Center, 19 June. Yuriy Romanenko and Aleksandr Laveykin have been working in near-Earth space for 19 weeks.

In line with the international program of astrophysical studies, two more series of experiments were conducted on 18 and 19 June. Observations of a neutron star in the constellation Cygnus were made with the X-ray observatory installed in the specialized module "Kvant." In the course of the prolonged space flight, doctors of the medical support group are constantly monitoring the condition of the health of the crew and how they are feeling.

A comprehensive examination of the cardiovascular systems of the commander and the flight engineer is scheduled for today. Recording of physiological parameters will be accomplished with the multifunctional clinical apparatus "Gamma-1."

During the day the crew also will prepare the ultraviolet telescope "Glazar" for upcoming work.

According to reports from orbit and telemetry data, the flight of the manned complex "Mir" is proceeding according to the designated program.

FTD/SNAP
/8309
CSO: 1866/110

THIRD SOLAR PANEL CONNECTED TO 'MIR' POWER SUPPLY SYSTEM

Moscow PRAVDA in Russian 24 Jun 87 p 1

[TASS Report]

[Text] Flight Control Center, 23 June. The prolonged space mission of Yuriy Romanenko and Aleksandr Labeykin is continuing.

The crew's program of work during the days just past included technical experiments, routine maintenance of individual systems and instruments of the complex, and observations of meterological processes taking place in the atmosphere.

The crew has carried out final operations for switching of electrical circuits inside the base block and has connected the third solar battery to the unified power supply system of the orbiting complex "Mir."

Today, Yuriy Romanenko and Aleksandr Laveykin are working chiefly on preparing scientific apparatus for upcoming research and experiments.

Both cosmonauts are feeling well.

The flight of the orbiting complex "Mir" is proceeding normally.

FTD/SNAP
/8309
CSO: 1866/110

CREW EXPERIMENTS WITH POLYMER STRUCTURAL MATERIALS, METAL COATINGS

Moscow MOSKOVSKAYA PRAVDA in Russian 27 Jun 87 p 2

[Text] Flight Control Center, 26 June. Yuriy Romanenko and Aleksandr Laveykin have been working in near-Earth orbit for 20 weeks.

In the days just past, the crew of the "Mir" manned complex did routine work with equipment and onboard systems, and performed geophysical and technological experiments.

In line with the plan for adding equipment to the station, the cosmonauts replaced one of the units of the onboard information system "Strela." The adding of an improved unit to this system substantially expands the crew's capabilities for controlling onboard systems and instruments of the manned complex.

A technical experiment called "Biostoykost" (biostability) has begun on board the station. It is being conducted for the purpose of studying possibilities of using various polymer compounds as structural materials that could be used in developing new space instruments and equipment.

In line with the program of space materials studies, another series of experiments in the "Yantar" unit has been completed. The purpose of these experiments is to perfect a process for application of thin metal coatings in conditions of vacuum and zero gravity.

Today's program of work includes several medical monitoring examinations. In particular, examinations of the cardiovascular systems of both cosmonauts will be conducted.

In line with the international program of astrophysical studies, four sessions of measurements using the telescopes of the "Rentgen" observatory are planned for today. The observations will be directed at the Centaurus constallation.

According to telemetry data and the crew's reports, the flight is proceeding according to the designated program. Both cosmonauts are feeling well.

FTD/SNAP
/8309
CSO: 1866/110

COSMONAUTS BEGIN OBSERVATIONS WITH 'GLAZAR' UV TELESCOPE

Moscow SOVETSKAYA ROSSIYA in Russian 1 Jul 87 p 5

[TASS Report]

[Text] Flight Control Center, 30 June. Yuriy Romanenko and Aleksandr Laveykin have been working in near-Earth orbit for 145 days.

In the days just past, the crew conducted astrophysical and geophysical experiments, and performed a medical examination.

In line with the international program of research called "Rentgen," 10 series of measurements were performed. All of the X-ray telescopes during sessions of observations were aimed at the Centaurus constallation.

Work in line with yet another program of astrophysical studies has begun on board the "Mir" manned complex. Specialists of Switzerland are taking part in these studies together with Soviet scientists. Inside the specialized module "Kvant" is the ultraviolet telescope "Glazar," which was developed at the Byurakan Astrophysical Observatory. The first photographs have been made of various sectors of the sky in the ultraviolet band of electromagnetic radiation.

The work schedule today includes astrophysical experiments, planned preventive-maintenance work with equipment and onboard systems, and physical exercise.

In line with the plan of medical monitoring, a study has been made of the bioelectric activity of the cosmonauts' hearts while at rest.

According to the crew's reports and telemetry data, the flight of the "Mir" orbiting complex is proceeding according to the designated program.

FTD/SNAP
/8309
CSO: 1866/110

COSMONAUTS COMPLETE 21ST WEEK IN ORBIT

Moscow SOVETSKAYA ROSSIYA in Russian 4 Jul 87 p 1

[TASS Report]

[Text] Flight Control Center, 3 July. Yuriy Romanénko and Aleksandr Laveykin have completed their 21st week of orbital flight.

In line with the program for study of Earth's natural resources and environment, the crew of the "Mir" manned complex has performed several more series of photography of various regions of our country's territory.

In line with the medical research plan, the cosmonauts have conducted an experiment for the purpose of working out a procedure for making clinical analyses of blood in conditions of weightlessness. The work that is being done is the first of its kind in the practice of space flight.

Today's schedule calls for the crew to install a new astrotracker, and to begin preparing biotechnological units for upcoming experiments.

During the day the cosmonauts also will inventory medical equipment and will do other routine work. According to results of medical monitoring, the commander's pulse rate is 66, and that of the flight engineer is 55 beats per minutes. Their blood pressures are, respectively: 120 over 70, and 115 over 60 millimeters of mercury. Both cosmonauts are feeling well.

FTD/SNAP
/8309
CSO: 1866/110

COSMONAUTS CONDUCT PHOTOGRAPHY, REFUELING OPERATIONS

Moscow PRAVDA in Russian 8 Jul 87 p 1

[TASS Report]

[Text] Flight Control Center, 7 July. Cosmonauts Yuriy Romanenko and Aleksandr Laveykin have been in near-Earth orbit for five months.

In line with the program for study of Earth's natural resources and environment, several more series of geophysical experiments were conducted in the days just past. Photographing of various regions of our country, including the Southern Urals, the Caspian Lowland and the Far East, was done on board the "Mir" manned complex.

In line with the plan of work with the "Progress-30" unmanned cargo ship, the combined engine unit has been refueled.

Today the crew has been busy with preventive-maintenance work on the temperature-control system, and with adjusting the new astrotracker. In line with the international program of astrophysical studies using the telescopes of the "Rentgen" observatory, observations are being made of an X-ray source in the constellation Cygnus.

According to the crew's reports and telemetry data, the flight is proceeding according to the designated program. The cosmonauts are feeling well.

FTD/SNAP
/8309
CSO: 1866/110

ROMANENKO AND LAVEYKIN CONTINUE EXPERIMENTAL PROGRAMS ABOARD 'MIR'

Moscow IZVESTIYA in Russian 11 Jul 87 p 1

[TASS Report]

[Text] Flight Control Center, 10 July. Yuriy Romanenko and Aleksandr Laveykin are continuing to carry out planned work on board the manned complex "Mir."

In line with the program of biological research with the "Svetoblok" unit, a series of experiments has been performed for the purpose of obtaining a synthetic gel, which will be used in electrophoretic purification of substances on Earth.

A correction of the orbiting complex's trajectory of movement has been executed, using the engine of the unmanned spaceship "Progress-30."

Another series of geophysical experiments has been completed. Territories of the Crimea and Krasnodar Kray were selected as areas for photographing.

In line with the space materials science program, the latest experiments with the "Yantar" apparatus have been performed for the purpose of perfecting methods of applying metal coatings in conditions of vacuum and zero gravity.

In line with the plan for further equipping of the base block, the crew has installed a technological unit, "Kristallizator," which was made by specialists of Czechoslovakia and is intended for obtaining crystals of various materials. Plans call for switching on this unit today, in order to measure characteristics of its temperature pattern.

The program for the day also includes medical examinations of the crew, preventive maintenance work on the station's life support system, and two hours of physical exercises.

The flight of the manned complex "Mir" is proceeding in line with the designated program.

FTD/SNAP
/8309
CSO: 1866/110

COSMONAUTS CONTINUE PHOTOGRAPHY, MATERIALS, ASTROPHYSICAL STUDIES

Moscow IZVESTIYA in Russian 15 Jul 87 p 2

[TASS Report]

[Text] Flight Control Center, 14 July. The flight of the manned complex "Mir" is continuing.

Within the framework of the program for study of Earth's natural resources and environment, Yuriy Romanenko and Aleksandr Laveykin photographed territories of the Far East, Moldavia, the Crimea, the Pamir Mountains and the Caspian Lowland during the days just past, using stationary cameras and spectrometers.

Several more experiments with the technological unit "Kristallizator," which was built by specialists of Czechoslovakia, have been performed in line with the space materials science program.

In line with the international program of astrophysical research, observations of various X-ray sources in the constellations Cygnus, Centaurus and Hercules have been conducted with the aid of telescopes of the "Rentgen" observatory, which is installed in the specialized module "Kvant."

Refilling of the base block's combined engine unit with an oxidizing agent is planned for today, in line with the plan of work with the unmanned cargo spaceship "Progress-30." Also planned are medical monitoring examinations of the cosmonauts, and two hours of physical exercise with the stationary bicycle and the running track.

According to telemetry data and the crew's reports, work in near-Earth orbit is proceeding in accordance with the planned flight program.

FTD/SNAP
/8309
CSO: 1866/110

COSMONAUTS PHOTOGRAPH POLAND FOR INTERNATIONAL ECOLOGY PROJECT

Moscow IZVESTIYA in Russian 18 Jul 87 p 1

[TASS Report]

[Text] Flight Control Center, 17 July. Yuriy Romanenko and Aleksandr Laveykin have completed their 23d week of space flight.

In the days just past, the crew of the "Mir" manned complex conducted a number of astrophysical studies using the "Rentgen" observatory and the "Glazar" ultraviolet telescope, and they continued work in geophysics and biology. In line with the plan of work with the "Progress-30" cargo ship, the combined engine unit of the base block was refilled with fuel and oxidizer.

On 15 July in line with an aerospace experiment called "Tele-geo-87," the cosmonauts photographed separate regions of the territory of the Polish People's Republic. They performed this work as part of an international coordinated project called "Study of the Dynamics of Geosystems by Remote Methods."

The objective of this experiment, which is being carried out by specialists of socialist countries, is to perfect methods for the study of various ecological systems using aerospace means of remote sensing of Earth. Photographing of the Earth's surface from on board the "Mir" complex was done at the same time as photographing from laboratory airplanes.

Plans for today call for several sessions of studies in extra-atmospheric astronomy, which are being conducted according to an international program using the "Glazar" ultraviolet telescope.

According to the crew's reports and telemetry data, the flight of the "Mir" orbiting complex is proceeding normally.

FTD/SNAP
/8309
CSO: 1866/110

UNDOCKING, DESTRUCTIVE REENTRY OF 'PROGRESS-30'

Moscow PRAVDA in Russian 20 Jul 87 p 1

[TASS Report]

[Text] Flight Control Center, 19 July. The flight of the "Progress-30" unmanned cargo ship, which was launched into near-Earth orbit on 19 May 1987, has ended.

The ship had been flying as part of the "Mir" manned complex since 21 May. All of the operations that were planned for this period, which included unloading of its cargo, refueling the base block and transferring drinking water to it, were fully completed. A correction of the trajectory of movement of the manned complex was executed with the aid of the engine of the "Progress-30" ship.

Today at 0420 hours Moscow time, the "Progress-30" unmanned cargo ship was separated from the "Mir" manned complex.

Then on commands from the Flight Control Center, the unmanned ship's engine was fired. As a result of braking, "Progress-30" went into a descending trajectory, entered the dense layers of the atmosphere, and ceased to exist.

Yuriy Romanenko and Aleksandr Laveykin are in their 164th day of space flight.

In line with the international program of astrophysical studies, experiments for the study of various sources of ultraviolet radiation in the constellation Puppis will be continued today with the aid of the "Glazar" telescope.

Also planned are geophysical experiments and medical monitoring examinations.

According to reports from orbit and telemetry data, the flight of the manned complex is proceeding according to schedule.

FTD/SNAP
/8309
CSO: 1866/110

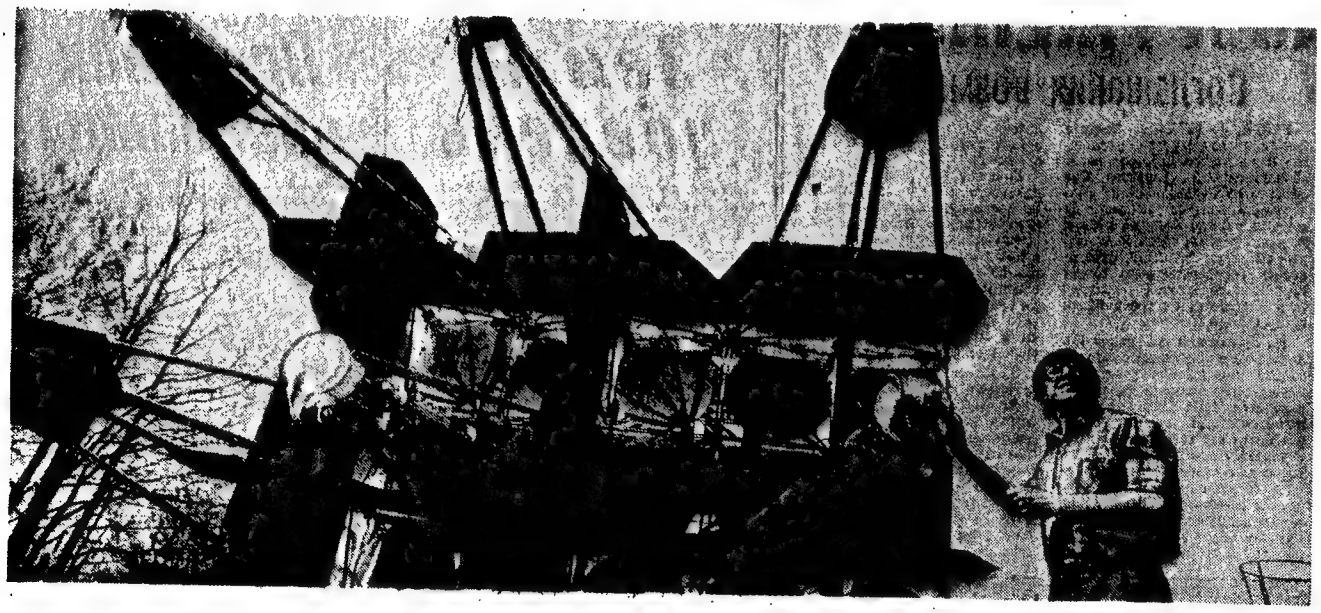
GAMMA-RAY TELESCOPE AT CRIMEAN ASTROPHYSICAL OBSERVATORY

Moscow PRAVDA in Russian 5 Jun 87 p 3

[Text] At the Crimean Astrophysical Observatory a gamma telescope is being created to record superhigh-energy particles entering Earth's atmosphere from space. Experimental work with the instrument is now under way.

(Photo caption: V. Shitov, scientific worker at the observatory, adjusts the instrument.)

CSO: 1866/111-P



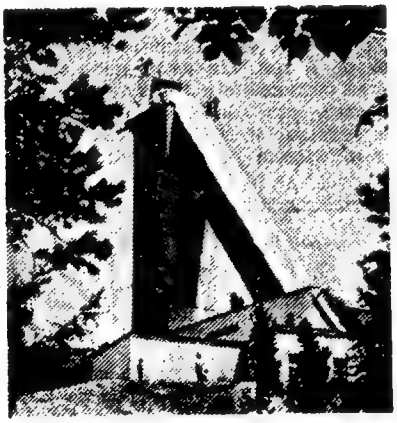
IZMIRAN SOLAR TELESCOPE COMPLETED AT LAKE BAYKAL

Moscow PRAVDA in Russian 1 Jun 87 p 4

[Text] Construction of a large solar vacuum telescope has been completed at Lake Baykal in Irkutsk Oblast. Scientists of the Siberian Institute of Terrestrial Magnetism, Ionosphere and Propagation of Radio Waves have received a unique instrument for studying the sun.

(Photos show the telescope building and workers adjusting a mirror.)

CSO: 1866/112-P



RESEARCH AT MAIN OBSERVATORY OF UKRAINIAN ACADEMY OF SCIENCES

Tallinn SOVETSKAYA ESTONIYA in Russian 7 May 87 p 1

[Text] Kiev. The Main Observatory of the Ukrainian Academy of Sciences is the republic's center for astronomy studies. The department of basic astrometry has developed an automated complex which performs high-precision observations of artificial Earth satellites.

Results of studies here are used extensively in preparing and carrying out experiments in space, in mapping of the moon, and in developing space navigation systems and time-measurement systems.

Plans of an all-Union scientific program, "Scanning of the Northern Sky," call for studying more than 200,000 stars. Research data are processed quickly on computers, and photographs are processed on a double wide-angle astrograph, which is an automated measuring machine.

Associates of the department of basic astrometry are working on theoretical problems of developing universal coordinate systems in space, which are needed both by astronomers and for supporting flights to other planets.

(A photograph is given showing a telescope at the observatory.)

FTD/SNAP
/8309
CSO: 1866/110

UDC 524.86H

ANISOTROPY OF RELIC RADIATION DURING PERIOD OF SECONDARY IONIZATION OF COSMOLOGICAL HYDROGEN

Moscow ASTRONOMICHESKIY ZHURNAL in Russian Vol 64 No 1, Jan-Feb 87 (manuscript received 29 Jul 85) pp 1-14

[Article by Ye.I. Dorosheva and P.D. Naselskiy, Physics Scientific Research Institute, Rostov State University]

[Abstract] Experimental data on the small-scale angular anisotropy of relic electromagnetic radiation are an important source of information on the early universe. This approach was used in a study of generation of small-scale anisotropy using models with secondary ionization of pregalactic matter. In the modeling it was postulated that the source of excess radiation is high-energy quanta arising during the decay of unstable massive particles or primordial black holes. The kinetics of ionization and hydrogen recombination were studied and the principal variants of change in plasma optical thickness were computed. The following aspects of the problem are examined in detail: rates of heating and ionization of plasma, dynamics of nonequilibrium ionization of plasma. small-scale anisotropy in models with nonequilibrium ionization of hydrogen. It is demonstrated that nonequilibrium ionization of pregalactic plasma is an effective mechanism of attenuation of small-scale anisotropy of relic radiation, but in the range $\alpha \gg 5°$ there is no significant $\Delta T/T$ change. This is attributable to the fact that the principal contribution to large-scale anisotropy of relic radiation is from perturbations of a scale λ comparable to or exceeding the horizon at the time of clearing of plasma for radiation. This circumstance is important for clarifying the hypothesis of nonequilibrium ionization of hydrogen. The discovery of fluctuations of relic radiation temperature in the range $\alpha \gg 5°$ and proof of absence of small-scale fluctuations at the level 10^{-5}-$3 \cdot 10^{-6}$ in the range $\alpha \simeq$ 5-20 minutes of angle would be strong support for the concept of nonequilibrium ionization of pregalactic plasma. Figures 6; references 23: 12 Russian, 11 Western.

5303/8309
CSO: 1866/75

OUTBURST FREQUENCY AND SPATIAL DISTRIBUTION OF TYPE I AND TYPE II SUPERNOVAE

Moscow ASTRONOMICHESKIY ZHURNAL in Russian Vol 64 No 1, Jan-Feb 87 (manuscript received 27 Mar 85) pp 79-89

[Article by D.Yu. Tsvetkov, State Astronomical Institute imeni P.K. Shternberg]

[Abstract] Data on the frequency of outbursts (flares) and spatial distribution of supernovae constitute an important source of information on the nature of supernova progenitors. Using observational data from the supernova service (State Astronomical Observatory and Asiago Observatory) a study was made of outbursts of supernovae of types I and II in galaxies of different morphological types, including a comparison of the spatial distribution of SN I and SN II in spiral galaxies. Analysis of the data for the period approximately 1960-1983 indicates absence of significant differences in the statistical characteristics of SN I and SN II. The frequencies of their outbursts are identical in most spiral galaxies. The radial distributions and mean z-coordinates also are the same and give evidence that the supernovae belong to the young population I. A comparison of the frequency of outbursts and rate of star formation revealed that in the main sequence the supernova progenitors should have a mass of at least $\geq 4M$. The sole difference is an absence or very low frequency of SN II in E and SO galaxies. There is no evidence to support Dallaporta's hypothesis that there are two types supernova progenitors I. The evidence supports the hypothesis that at the beginning of evolution supernovae of both types have masses from one or close intervals and even prior to an outburst the difference cannot be too great and is probably manifested in a different chemical composition and structure of the envelope. Figures 3; references 42: 14 Russian, 28 Western.

5303/8309
CSO: 1866/75

UDC 521.85:524/387

DETECTION OF CLOSE BINARY SYSTEMS BY OBSERVATIONS OF LUNAR OCCULTATIONS OF STARS USING 6-METER TELESCOPE

Moscow ASTRONOMICHESKIY ZHURNAL in Russian Vol 64 No 1, Jan-Feb 87 (manuscript received 30 May 85) pp 108-118

[Article by G.M. Beskin, M.B. Bogdanov, S.I. Neizvestnyy, A.A. Pimonov, V.L. Plakhotnichenko and V.F. Shvartsman, Special Astrophysical Observatory, USSR Academy of Sciences; Saratov State University]

[Abstract] The greatest possibilities of the occultations method were evaluated when using the 6-meter BTA [large azimuthal telescope] system and a search was made for close binary systems whose angular dimensions are less than the BTA diffraction range ($\sim 0''.02$). Observations were made in 1981-1982 at the Special Astrophysical Observatory, using a primary focus electrophotometer, special "time-code" converter and SM-4 computer and other instrumentation described in detail in observatory publications. Photoelectric observations of occultations of 10 stars by the moon are given. The brightness strip-distribution of the occulted source was retrieved using a modified regularization method in which a priori information on non-negativity of the solution is taken into account. Upper limits were found for the angular diameters of eight stars, for one of which with $m_V = 11^m.07$, an angular resolution $0''.0101$ was obtained, the best resolution ever obtained for objects fainter than 10^m. Two close binary systems were discovered. With respect to this particular telescope and the recording instruments employed, the brightness of an object up to which the occultation method ensures a higher angular resolution than the speckle interferometry method is close to $m_R \sim 14\text{-}15^m$. Observations of occultations of quasars or other faint extragalactic objects in the visible spectral range are therefore not feasible. The best possible use of the occultation method is a search for close binaries. Figures 2; references 30: 16 Russian, 14 Western.

5303/8309
CSO: 1866/75

UDC 629.783:523.4/5:521.4

METHOD FOR DETERMINING PERTURBED ORBITS OF UNKNOWN COSMIC OBJECTS FROM OPTICAL OBSERVATIONS

Moscow ASTRONOMICHESKIY ZHURNAL in Russian Vol 64 No 1, Jan-Feb 87 (manuscript received 30 Jan 85) pp 187-195

[Article by N.I. Perov, Yaroslav State Pedagogic Institute]

[Abstract] A direct method is proposed for computing the position and velocity vectors of unidentified artificial celestial bodies within the framework of the generalized problem of two fixed centers on the basis of measurements of the angular coordinates (α_k, δ_k, $k = \overline{1, n}$). A method is given for computing $\dot{L}$ and $\ddot{L}$ (direction cosines of topocentric vectors of positions of artificial earth satellites) on the basis of optical observations, using orthogonal Chebyshev polynomials. Methods were developed for determining $\dot{L}$ and $\ddot{L}$ on short, intermediate and long arcs, as well as topocentric distance to a satellite, for the mean observation time. An example of the computations is given. An analysis of direct methods for determining the preliminary orbits of artificial earth satellites from optical observations in different variants of the problem of two fixed centers and the Keplerian problem revealed that elements of initial satellite orbits should be computed within the framework of the generalized problem of two fixed centers. The use of orthogonal Chebyshev polynomials for approximating the $L(\tau)$ vector made it possible to determine preliminary satellite orbits on long arcs when there are dense observation series with lesser computation time than when $L(\tau)$ is represented in the form of a polynomial, regardless of its degree. The elements of preliminary orbits of earth satellites determined from optical observations in intermediate motion models are more effective than the elements of a Keplerian orbit when computing search ephemerides and improving preliminary satellite orbits. With some modification the method can be used in finding the preliminary orbits of natural celestial bodies. References: 5 Russian.

5303/8309
CSO: 1866/75

UDC 525.73(-922/-923)

ASTRONOMIC REFRACTION IN POLAR REGIONS BASED ON AEROLOGIC SOUNDINGS

Moscow GEODEZIYA I KARTOGRAFIYA in Russian No 1, Jan 87 pp 17-20

[Article by F.D. Zablotskiy and L.A. Kulish]

[Abstract] Theoretical studies of refraction at high zenith distances were performed and magnitudes were estimated as a function of time of year and position of observation point in order to determine the suitability to the polar regions of the standard Soviet tables for astronomic refraction. The materials used were many years of mean monthly data on temperature and relative humidity at standard isobaric surfaces at polar stations. The astronomical refraction was computed for each atmosphere model for zenith distances of 0° to 90°. It was found that in the polar regions, particularly the central Antarctic, existing tables do not properly consider astronomic refraction for observations at great zenith distances. Solution of the problem will require careful investigation and development of optimal atmosphere models to be used as a basis for tables to consider astronomic refraction in the polar regions. The model must consider stratification of the atmosphere, particularly the layer near the ground, the specific nature of the inclination of layers of equal density caused by the dome-like surface in the Antarctic and the near constant wind direction and the physical and climatic differences between the continent and the sea in the Arctic.

References 7: Russian

6508/8309
CSO: 1866/58

UDC 629

NUMERICAL SOLUTION OF MINIMAX PROBLEM OF EVALUATING PARAMETERS OF MOTION IN PRESENCE OF UNSIMULATABLE ACCELERATIONS

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 25 No 1, Jan-Feb 87 (manuscript received 25 Apr 86) pp 3-17

[Article by M.L. Lidov and V.A. Lyakhova]

[Abstract] The problem of evaluating the parameters of motion in the presence of unsimulatable accelerations was explored by M.L. Lidov in an earlier article (KOSMICH. ISSLED., Vol 24 No 2, p 246, 1986). The fundamental principles of the problem were formulated and applied in writing an algorithm for numerical solution of the problem with a discrete set of measurements. An analytical evaluation approach cannot be used for multivariate problems of this nature. In this article, representing a continuation of the earlier study, the great difficulties in writing an adequately universal algorithm suitable for automatic solution of a wide range of problems is made clear. An algorithm has now been written. Its use is illustrated by solution of a simple problem. The motion of a two-dimensional system is described by the equations $\dot{x}_1 = u(t)$, $\dot{x}_2 = x_1$, where $u(t)$ is an unsimulatable acceleration limited in absolute value by a stipulated function $\gamma(t) : |u(t)| \leqslant \gamma(t)$. The minimax problem of evaluating the parameter $\ell = a_1x_1(0)+a_2x_2(0)$ from $x_2(t)$ measurements in a discrete set of moments in time t is examined. An algorithm is given for numerical determination of a linear evaluator which minimizes the error in evaluating the ℓ parameter for the worst combinations of measurement errors and form of the u(t) function. Reference: 1 Russian.

5303/8309
CSO: 1866/68

UDC 521.225

PROBLEM OF TRANSLATIONAL-ROTATIONAL MOTION OF THREE SOLID BODIES

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 25 No 1, Jan-Feb 87 (manuscript received 25 Mar 85) pp 18-22

[Article by Zh.B. Rakishev]

[Abstract] The restricted circular problem of translational-rotational motion of three reciprocally gravitating solid bodies was studied. As the problem is formulated, it is assumed that the bodies M_0 and M_1, which are spheres with a radial density distribution and the masses m_0 and m_1 ($m_0 > m_1$), move in circular Keplerian orbits relative to their common center of mass 0 with the mean motion n. The translational motion of a passively dynamically symetric solid body M_2 with the mass m_2 occurs at such a distance from the centers of mass of the bodies M_0 and M_1 that it considerably exceeds the distance between these bodies. As the unperturbed orbital motion of the body M_2 use is made of the Keplerian motion of its center of mass relative to M_0, whereas the Eulerian motion of the body M_2 is used for rotational motion. A number of coordinate systems are introduced for solving the problem and relative translational-rotational motion of the body is described by canonical osculating elements. An expansion into a multiple Fourier series is carried out for the approximate value of the force function. A new averaging scheme is introduced for arrival at a family of particular solutions and the required first-approximation stability conditions are found for these solutions. Figure 1; reference: 1 Russian.

5303/8309
CSO: 1866/68

UDC 65.012.2:629.198.3

OPTIMIZING EXPERIMENTAL PROGRAMS IN OPERATIONAL PLANNING OF RESEARCH CARRIED OUT FROM SPACECRAFT

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 25 No 1, Jan-Feb 87 (manuscript received 4 Mar 85) pp 30-36

[Article by M.Yu. Belyayev and D.N. Rulev]

[Abstract] An integrated approach is given for optimal preparation of an experimental program for flights of orbital stations of the "Salyut" type. Since the number of desirable experiments far exceeds the possibilities for a particular flight, priorities must be assigned and potential information yields must be evaluated. A whole series of factors must be weighed: number of regions observable in a zone, time during which these regions are observable, and area of the regions. At the same time, the restrictions applicable during a specific time interval, such as availability of photographic film and magnetic tape for scientific instruments, fuel, working time of crew and others must be considered. For evaluating the quality of planning of experimental programs during a particular flight interval there is an expression which characterizes the information yield of observations when allowance is made for priorities, optimum solar altitude, maximum cloud cover during observations and other factors. It is shown that the operational planning of experiments is essentially a linear programming problem. A set of programs for a BESM-6 computer was developed for use with this method. A specific example is given. Plans called for observations of a certain list of regions during a short time period ("Salyut-7," 20-24 August 1984). For each region the program stipulated the priority of its observation, admissible range of solar altitudes, and instrument field of view. The maximum length of an experimental zone was 3 revolutions and the interval between zones was not less than 1 revolution. A table was prepared giving the requirements on such resources as film, fuel and crew working time for each zone (total of 26 zones). References: 5 Russian.

5303/8309
CSO: 1866/68

UDC 629.78

SOLVING OPTIMAL ATMOSPHERIC ENTRY CONTROL PROBLEMS

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 25 No 1, Jan-Feb 87
(manuscript received 11 Dec 85) pp 37-46

[Article by Yu.F. Golubev and R.Z. Khayrullin]

[Abstract] In solving optimal control problems for atmospheric entry of different types of spacecraft into the atmospheres of different planets the atmospheric parameters and aerodynamic characteristics of spacecraft, as well as functionals and limitations, can be stipulated in the form of tables greatly facilitating computation work. The procedures for numerical analysis and preparation of computation programs must be automated and this has been facilitated by the proposed SAFRA set of practical programs, described in the literature. A modification of the successive linearization method defined earlier by the authors (Preprint No 157, Moscow, IPM AN SSSR, 1985) is proposed which makes it possible to carry out the iterative procedure of search for optimal control in a class of step functions and continuous piecewise-linear functions. This proposed modification is the basis for functional filling of the SAFRA set of practical programs written for solution of a number of optimal control problems arising in atmospheric entry. These procedures are being applied with success using a BESM-6 computer. Computations of atmospheric parameters and aerodynamic characteristics are made using auxiliary programs which employ formulas for quadratic and cubic interpolation between the elements of the corresponding tables. The practical programs have been used in numerical solution of the problem of determining the attainability region and in ascertaining the range of possible final velocities for atmospheric entry trajectories leading to a stipulated point. Figures 5; references: 9 Russian.

5303/8309
CSO: 1866/68

UDC 550.383

INFLUENCE OF LARGE-SCALE SOLAR WIND DISTURBANCES ON DYNAMICS OF OUTER RADIATION BELT RELATIVISTIC ELECTRONS

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 25 No 1, Jan-Feb 87 (manuscript received 22 Oct 85) pp 64-73

[Article by I.P. Bezrodnykh, Ye.I. Morozova and Yu.G. Shafer]

[Abstract] Streams of high-energy ($E_e \sim 1$ MeV) electrons were measured on the "Prognoz-6," "Prognoz-7" and "Raduga" satellites for studying the relationship between increases in electron intensity in the outer magnetosphere and large-scale solar wind disturbances. About 50 measurements were made of intensity increases in the outer radiation belt, revealing a dependence of electron intensity on solar wind velocity. It was found that the maximum of the stream of relativistic electrons lags by $\sim$2.5 days relative to the solar wind velocity maximum. A comparison of electron intensity at the magnetopause and in the outer radiation belt with solar wind velocity indicated that with an increase in solar wind velocity there is an increase in electron intensity at the magnetopause and in the outer radiation belt. An increase in electron intensity at the magnetopause occurs earlier than in the outer radiation belt ($L \sim 6.6$). The predicted time of diffusion of high-energy electrons from the boundary of the magnetophere to $L \sim 6.6$ agrees well with the observed lag time of the maximum increase in the stream of relativistic electrons at $L \sim 6.6$ relative to the solar wind velocity maximum. It is postulated that increases in the stream of relativistic electrons in the outer radiation belt may be related to an intensification of the radial diffusion of electrons from the boundary of the magnetosphere, assuming that a source of high-energy electrons is situated at the boundary of the magnetosphere. The effect of high-velocity solar wind streams on the geomagnetosphere involves electron acceleration near the magnetopause and an intensification of transfer of high-energy particles (both accelerated near the magnetopause and existing in the interplanetary medium) into the depths of the magnetosphere. Figures 7; references 16: 10 Russian, 6 Western.

5303/8309
CSO: 1866/68

UDC 551.510.535.2

COMPARISON OF SATELLITE MEASUREMENTS OF ELECTRICAL AND MAGNETIC FIELDS AND PARTICLE STREAMS WITH SURFACE GEOPHYSICAL DATA IN EARLY MORNING SECTOR OF AURORAL ZONE

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 25 No 1, Jan-Feb 87
(manuscript received 7 Feb 85) pp 74-85

[Article by N.V. Isayev, A.G. Yakhnin, S.V. Bilichenko, T.N. Kolosova, V.I. Lazarev, R. Pellinen, N. Petkov, T. Stanev, M.V. Teltsov, D. Teodosiyev, Ye.Ye. Timofeyev, Ye.P. Trushkina, V.M. Chmyrev and S.I. Shkolnikova]

[Abstract] An analysis of "Intercosmos-Bolgariya-1300" satellite data afforded a possiblity for clarifying the interrelationship of different auroral structures when used in combination with surface data. The studied data were for two satellite transits near the Kola Peninsula, where several magnetometers were in operation and surface observations of radioauroras and auroras were made. These transits were of particular interest because they applied to the morning sector of the auroral zone, a sector which has been poorly studied. An analysis was made of the relationship between longitudinal currents and the electrical field; relationship between longitudinal currents and characteristics of injected electrons; relationship between auroral structures, longitudinal currents and the electrical field. The terminology introduced by T. Iijima, et al. ("zones 1 and 2") in JGR, Vol 81, p 2165, 1986, is used. The longitudinal currents in zone 2 are associated with the inner region of the plasma sheet, the source of leaking electrons with $E \approx 1$-5 keV, responsible for a diffuse glow. Current intensity decreases toward the equator. The region of particle injections can extend considerably south of the zone of intensive currents. The data revealed the nature of fields between zones 1 and 2 and within these zones. The center of the westerly electrojet was on the poleward boundary of diffuse auroras in the region of currents in zone 2. A diffuse radioaurora was observed in the region between layers of longitudinal currents in zones 1 and 2. Poleward of zone 1 there is a region of injection of accelerated electrons which is projected onto the outer boundary of the plasma layer. Figures 4; references 33: 8 Russian, 25 Western.

5303/8309
CSO: 1866/68

UDC 533.951.2

OBSERVATIONS OF RECURRENT HIGH-VELOCITY SOLAR WIND STREAMS IN DECLINING PHASE OF SOLAR ACTIVITY CYCLE 21 USING WIDE-ANGLE ION ENERGY SPECTROMETER ABOARD 'PROGNOZ-9' SATELLITE

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 25 No 1, Jan-Feb 87 (manuscript received 10 Nov 85) pp 86-92

[Article by K.I. Gringauz, V.V. Bezrukikh, M.N. Verigin and G.A. Kotova]

[Abstract] Solar wind measurements made on the "Prognox-9" satellite during the period July 1983 through February 1984 in the declining phase of solar cycle 21 afforded a possibility for checking the reliability of conclusions concerning long-period variations of solar wind properties drawn on the basis of earlier experiments. Measurements of the plasma ion component were made by the modulation method using the D-137A ion energy spectrometer. Although of brief duration (8 months), the solar wind measurements were virtually continuous (unlike earlier measurements) and the data collected on the structure of high-velocity streams was quite complete. In the solar wind during this period there were recurrent high-velocity streams which were stable over the course of 5-6 solar rotations. In most cases during a solar rotation there were 4 high-velocity streams, in conformity to the 4-sector structure of the interplanetary magnetic field in the plane of the ecliptic. The velocity in some of these streams attained 700-800 km/s. The data demonstrate a renewal of the regular structure of high-velocity streams in the solar wind in the declining phase, as predicted earlier on the basis of solar wind measurements in the preceding cycle, indicating that the presence of recurrent high-velocity streams in the declining phases of the 11-year solar cycles is a regular feature in such cycles. Figures 3; references 16: 4 Russian, 12 Western.

5303/8309
CSO: 1866/68

UDC 533.951.2

DEPENDENCE OF SOLAR WIND VELOCITY ON DISTANCE TO HELIOSPHERIC CURRENT SHEET ACCORDING TO 'PROGNOZ-9' SATELLITE DATA

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 25 No 1, Jan-Feb 87
(manuscript received 10 Nov 85) pp 93-102

[Article by G.A. Kotova, K.I. Gringauz, V.V. Bezrukikh, M.I. Verigin, L.A. Shvachunova, W. Riedler and K. Shvingenshu]

[Abstract] In another article in this same issue of the journal (K.I. Gringauz, et al.) "Prognoz-9" data were used in demonstrating a renewal of the regular structure of high-velocity solar wind streams in the declining phase of the current solar activity cycle. The fact that these measurements were made in the declining phase, when the structure of the heliospheric current sheet is most regular and the current sheet is at considerable distances from the plane of the ecliptic, favors a clarification of the dependence of solar wind parameters on angular distances to this formation. The high satellite orbit made it possible to obtain virtually continuous information on large-scale formations in the solar wind. Measurements of the ion component of plasma on this satellite were made using the D-137A modulation-type wide-angle energy spectrometer. A quantitative study was made of the dependence of solar wind velocity V on the angular distance λ to the heliospheric current sheet. The V (λ) dependence determined from all V measurements can be approximated by the empirical expression: $V\ (km/s) = 410 + 305 \sin^2$. The assumption that the mean solar wind velocity on the path from the "source surface" to Earth's orbit is less than V measured at 1 AU reduces the scatter of experimental points relative to the approximating curve. A method is proposed for evaluating the $\langle V \rangle / V$ ratio, the integral characteristic of the process of solar wind acceleration, on the basis of measurement of its parameters at 1 AU. Figures 7; references 15: 2 Russian, 13 Western.

5303/8309
CSO: 1866/68

UDC 551.521.6

OBSERVATIONS OF IONOSPHERIC TROUGH AT GREAT ALTITUDES USING 'PROGNOZ-5' SATELLITE

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 25 No 1, Jan-Feb 87 (manuscript received 6 Jul 85) pp 103-109

[Article by V.P. Grigoryeva and V.V. Pisareva]

[Abstract] The article gives the results of observations of the ionospheric trough at altitudes 1,000-6,000 m using the "Prognoz-5" satellite, which intersected the auroral gap in the southern hemisphere. The observations were made during a period close to the solar activity minimum (from January through June 1977). Apogee was in the northern hemisphere at a geocentric distance 200,000 km and perigee was in the southern hemisphere. During these observations perigee altitude varied from 1,100 to 3,000 km. Radio emission from the satellite was received in the frequency range 50-1000 kHz and registered using a cosmic radio emission analyzer at 10 discrete frequencies. The greatest width of the ionospheric trough was near the meridian passing through the south geomagnetic pole. During the equinoctial and summer observations the maximum width of the trough at ionospheric altitudes was $\sim 20°$ at $\lambda \sim 110°$F. In the region of the South American magnetic anomaly there is a peculiarity in position of the trough: a displacement (sometimes significant) toward the equatorial latitudes. In the morning hours the equatorial boundary of the trough at altitudes 4,000-6,000 km was at $L_0 \sim -62°$ and $L \sim 4.6$; in the evening hours at 2,000-3,000 km the equatorial boundary of the trough was at $L_0 \sim -60°$ and $L \sim 4$; at F_2-layer altitudes the trough in evening was at $L_0 \sim -55°$ and $L \sim 3.1$. This behavior of the plasmasphere boundary at different altitudes as a function of L_0 for $K_p \leqslant 3$ shows that in these MLT intervals it does not pass strictly along a magnetic line of force with a constant L_0: the plasmasphere is simplified in the morning hours and "drawn out" in the evening hours. Figures 4; references 11: 6 Russian, 5 Western.

5303/8309
CSO: 1866/68

UDC 533.951.2

MEASUREMENTS OF IONOSPHERIC ELECTRON TEMPERATURE USING LOW-FREQUENCY IMPEDANCE METER

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 25 No 1, Jan-Feb 87
(manuscript received 9 Sep 85) pp 110-117

[Article by V.I. Aksenov, A.P. Modestov and L.Yu. Sokolov]

[Abstract] Two new radiophysical methods are proposed for measuring electron temperature in the ionosphere. These methods are based on LF measurements of the impedance of a collapsible-whip antenna mounted on an artificial earth satellite. The first method is based on the dependence of active antenna conductivity on the electromagnetic force induced in the antenna during its motion in the Earth's magnetic field. The second method is based on the nonlinear dependence of active antenna conductivity on the amplitude of the low-frequency voltage fed to it. The errors of these methods for measuring T_e were analyzed and the sources of possible systematic errors and methods for taking them into account were examined. When measuring active antenna conductivity with an accuracy of about 92 percent and the amplitude of the low-frequency voltage in the antenna with an error not greater than 3 percent (as was the case when using the "Intercosmos-Kopernik 500" impedance meter) the attainable accuracy in determining T_e is $\simeq$10 percent. This accuracy can be increased by a factor of 2-3 by using more modern impedance-measuring techniques, assuming availability of satellite orientation data. These methods were tested on the "Intercosmos-Kopernik 500" satellite. T_e was measured at altitudes 185-700 km in the middle-latitude ionosphere during the period of the autumnal equinox at the solar activity minimum. The data collected on a pre-dawn increase in electron temperature and on the vertical variation of T_e at nighttime are consistent with T_e measurements made by other methods. Figures 5; references 16: 11 Russian, 5 Western.

5303/8309
CSO: 1866/68

UDC 533.9.07

RESEARCH ON CHARACTERISTICS OF MODULATED COLLECTOR CURRENT OF MULTIELECTRODE PROBE OF ORIENTATION ION SENSOR GENERATED BY SECONDARY ELECTRONS FROM ITS GRIDS

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 25 No 1, Jan-Feb 87 (manuscript received 21 Nov 85) pp 118-123

[Article by V.V. Skvortsov, M.B. Sukhovoy and A.A. Uspenskiy]

[Abstract] An earlier study by the authors (KOSMICH. ISSLED., Vol 23 No 4, p 547, 1985) gave the results of experiments for determining the reasons for the appearance of components of a modulated current in multielectrode probes of orientation ion sensors. These components are unrelated to modulation of the ion stream and disrupt the normal operating mode of the sensors. When these are present the angular characteristics of the instrumentation can be distorted to such a degree that its use is impossible. The research revealed that these effects arise when within the probe there is a possibility for modulation of streams of secondary electrons knocked from the electrodes (under the influence of primary electrons of adequately high energies or UV radiation quanta). These phenomena are extremely complex and are essentially dependent on the relation of potentials across the probe electrodes. On different segments of the volt-ampere characteristics the main contribution to the strength of the collector current is from electrons from different electrodes. This article is essentially a continuation of this work and provides more detail on the influence of the effects of secondary emission from different probe grids on formation of the modulated collector current component. Conditions were found under which secondary electrons can give rise to peaks of both an antiphase current and peaks of a phase current. Although a probe of simplified design was used in the experiments, the validity of the results was demonstrated. A grid with a variable secondary emission coefficient was used in ascertaining the influence of different secondary electron modulation mechanisms on the volt-ampere characteristics of the probe. For example, the results can be influenced by the physicochemical properties of the grid covering. The fuller understanding of these mechanisms resulting from this research made it possible to develop an AVC and modulation scheme for an orientation ion sensor which considerably suppresses these components. Figures 2; references 5: 3 Russian, 2 Western.

5303/8309
CSO: 1866/68

UDC 539.165

DETERMINING INTERVALS AND DATES OF ONSET OF CRITICAL ILLUMINATION CONDITIONS FOR SPACECRAFT INSTRUMENTS

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 25 No 1, Jan-Feb 87
(manuscript received 27 Sep 85) pp 141-147

[Article by I.D. Ibragimov and B.S. Shrebushevskiy]

[Abstract] Operation of many types of spacecraft instruments is dependent on their natural illumination. This article gives a quite general approach to solution of the problems involved in determining the intervals and dates of onset of critical conditions for instrument and system operation. The proposed methods are based on transformation of the vector conditions for critical illumination to trigonometric inequalities. It is assumed that perturbations of the spacecraft orbit osculating elements are negligible during one revolution and that the sun is at an infinite distance from the spacecraft and the center of the Earth and does not change its coordinates during one period of spacecraft revolution. The two variants of the solution are for elliptical and circular orbits and for stationary orbits as well. Particular attention is given to critical illumination of instruments oriented on a stipulated point on the Earth's surface and the problem of finding the intervals and dates of onset of the shadow. Figures 3; references: 6 Russian.

5303/8309
CSO: 1866/68

UDC 531.391

RESONANCE PHENOMENA ACCOMPANYING EVOLUTION OF TRANSLATIONAL-ROTATIONAL MOTION OF VISCOELASTIC PLANET

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 25 No 1, Jan-Feb 87 (manuscript received 25 Apr 86) pp 148-152

[Article by V.G. Vilke and K.M. Lebedev]

[Abstract] A number of earlier studies have described resonance rotations of a planet on the assumption that the planetary center of mass moves along an unperturbed Keplerian ellipse. This article gives a more general formulation of the problem in which the planetary orbit evolves due to the operation of internal dissipative forces. In this formulation there are three degrees of freedom rather than one. If the planet moves in a restricted region its motion tends to stationary rotation in which the center of mass moves in a circle and orbital angular velocity coincides with the angular velocity of the planet (resonance 1:1). The rate of evolution of planetary rotational motion was clarified. It was found that at resonances the rate of evolution of rotational motion can be sharply reduced: the planet for a quite long time will be in a resonance rotation mode. Nevertheless, orbital evolution continues and the system finally is no longer in a resonance mode. This evolution is demonstrated in the example of a planet with dynamic asymmetry, the motion of whose center of mass is described in canonical variables. References: 8 Russian.

5303/8309
CSO: 1866/68

UDC 629.197.2

SINGLE-IMPULSE TRANSFER FROM ARTIFICIAL EARTH SATELLITE ORBIT TO CONDITIONALLY PERIODIC TRAJECTORY AROUND COLLINEAR LIBRATION POINT OF SUN-EARTH SYSTEM

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 25 No 1, Jan-Feb 87 (manuscript received 27 Feb 86) pp 152-154

[Article by M.N. Boyarskiy and A.I. Sheykhet]

[Abstract] A class of trajectories for putting a spacecraft into a conditionally periodic trajectory about collinear libration points of the sun-Earth system with use of a single impulse for departure from an artificial earth satellite orbit was studied. All computations were made applicable to libration point L_2. It is assumed that the satellite orbit is circular with an altitude of 200 km and has a stipulated inclination in an ecliptic coordinate system and the longitude of the ascending node is variable. The flight from the satellite orbit to the libration point on the transfer trajectory is accomplished coplanarly. Since L_2 lies virtually in the plane of the ecliptic, it was assumed that the initial osculating elements for the geocentric transfer ellipse are governed by the condition that the line of apsides is in the plane of the ecliptic and pericenter altitude is equal to satellite orbital altitude. Since most of the flight trajectory is in a region of space where the gravitational influence of the sun and Earth is commensurable, the computations were made by numerical integration of the differential equations of motion with allowance for the influence of the Sun, Earth, Moon, Venus, Mars, Jupiter and Saturn. A special coordinate system was introduced for solving the formulated problem and various initial conditions were tested. The numerical analysis revealed that with an appropriate choice of initial parameters it is feasible to make a single-impulse transfer from an artificial earth satellite orbit into a conditionally periodic trajectory about a collinear libration point with an adequately long lifetime (six months or more, depending on initial conditions). Figures 2; references 3: 2 Russian, 1 Western.

5303/8309
CSO: 1866/68

UDC 551.521.8

BACKGROUND CONDITIONS FOR OBSERVING RADIO EMISSION OF ULTRAHIGH-ENERGY RADIO EMISSION PARTICLES

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 25 No 1, Jan-Feb 87 (manuscript received 16 Sep 85) pp 155-157

[Article by A.T. Abrosimov, Z. Klos, S.B. Lyakhov (deceased), G.G. Managadze, Yu.V. Mineyev, W.K. Riedler and M.F. Fridrikh]

[Abstract] An indispensable preliminary experiment for registry of the radio emission of particles of superhigh energies is a determination of background conditions in circumterrestrial space at altitudes above the ionosphere and for those frequencies of emission not reflected by the ionosphere. Measurements of the background conditions for registering the emission of extensive atmospheric showers were made during the G60S experiment. The instrumentation was placed in the separable nosecone of a "Vertikal" rocket launched on 18 September 1985 at 1800 UT. Maximum ascent altitude was 1,514 km. Measurements were made with a superheterodyne receiver with double frequency conversion. A study was made of measurements in the first frequency range 20-80 Hz. During one scanning cycle, measurements were made successively at 12 frequencies (spaced 5 MHz). A method was developed for constructing spectra averaged for several scannings (the averaged spectra were constructed for six successive scannings). An averaged spectrum was obtained for a time interval of about 2 s. A series of averaged spectra measured at different altitudes revealed that there are sharp peaks at definite frequencies, repeating from spectrum to spectrum, whose amplitude varies systematically with altitude. These peaks correspond to the radiation of TV and radio transmitters located both in the launching region and far from it. From an altitude of 1,500 km the receiver could register the radiation of trnasmitters situated at a distance up to 4,000 km. The change in amplitude of the peaks was associated with an increase in distance from source to receiver and their appearance at definite altitudes was attributable to the appearance of remote transmitters in the field of view. A study was also made of the level of the noise signal, uniformly distributed in frequency, as well as individual peaks not repeating from spectrum to spectrum. In future work it is proposed that the physical mechanism of radio emission be identified. Figures 2; references 2: 1 Russian, 1 Western.

5303/8309
CSO: 1866/68

UDC 551.510.536

ELECTRON KINETICS IN IONOSPHERIC D REGION UNDER CONDITIONS OF SIMULTANEOUS INCREASE IN IONIZATION LEVEL AND ELECTRON GAS TEMPERATURE

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 25 No 1, Jan-Feb 87
(manuscript received 6 May 86) pp 157-158

[Article by S.I. Kozlov]

[Abstract] The author earlier proposed a universal multicomponent aeronomic model which made possible a qualitative analysis of D-region behavior under a wide range of conditions (KOSMICH. ISSLED., Vol 20 No 6, p 881, 1982). This same model has now been used in a study of the kinetics of electrons at altitudes $60 \leqslant h \leqslant 80$ km when there is a simultaneous increase in the ionization level and electron gas temperature T_e. Such conditions can arise in the D-region in three cases: under the joint influence of different sources of artificial disturbance on the atmosphere (such as ionizing radiations and a powerful radio wave); when carrying out experiments with heating of the lower high-latitude ionosphere during the quite frequently observed occurrences of auroral absorption and absorption in the polar cap; due to the development of the ionization process itself under the influence of some ionizing agents. The universal model, since it provides for the possibility of broad variation of input parameters and the use of an extremely complete scheme of microprocesses (105 reactions) and the dependence of their rate constants on T_e and temperature T of the neutral gas, also made it possible to solve the formulated problem of D-region behavior when there is a simultaneous increase in the ionization level and electron gas temperature, as is illustrated by specific computations. References: 9 Russian.

5303/8309
CSO: 1866/68

SHEVCHENKO ON LUNAR BASE PROPOSAL

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 29 Jan 87 p 4

[Article by V. Shevchenko, Doctor of Physical and Mathematical Sciences: "Landing Site -- Oceanus Procellarum"]

[Text] "It is possible that we should create a permanent satellite of the moon...and on the moon, a primary base...It will be a rehearsal for flight to the planets..." (from the notebook of S. P. Korolev)

A spaceport on the moon, a gateway to deep space...Generations of scientists have envisioned it, and visionaries have dreamt of lunar cities. But today, specialists from various countries are already tracing their contours on plans.

Who is to say that our closest neighbor will not someday be so developed that it will be called the second home of mankind. In the meantime, our aims are more modest -- to create a scientific laboratory on the moon. Scientists are sure that it is here that they will find the answers to many of Earth's mysteries. Here one can conduct unique experiments that cannot be carried out on our planet, one can develop unprecedented technological processes. Were there an optical telescope on the moon, one could scrutinize the planets of almost a hundred of the nearest stars. And with a radiotelescope, one could peek at the boundaries of the universe. Not that the moon itself does not hold a good many secrets. Even now, for example, scientists debate its composition and origin. In order to answer all the questions, we need research, we need a permanent base.

But what would we build with on the moon?

With... the moon. Unmanned stations have delivered rock samples to Earth. Specialists have pulverized them, mixed them with water, and obtained...concrete. They experimented with baking the soil and proved that one could thus obtain bricks and construction blocks. Why, the rock itself provides excellent protection from cosmic radiation.

But where would we get metals? That problem is also solved -- lunar rock contains titanium, and iron, and aluminum, albeit in alloyed form. It is as if our companion has purposely hidden her riches until just the right time.

Riches like water, for example.

There is water on the moon. Only, it is hidden in stone -- in ilmenite. In order to "squeeze" it out, one must heat the rock along with hydrogen. Incidentally, a by-product of this reaction is pure iron. But where does one get hydrogen? From the surface. The solar wind has saturated the soil with it for billions of years.

Oxygen for breathing can be gotten from that same ilmenite, if you simply heat it. A kilogram of the mineral yields more than one hundred grams of oxygen!

In a word, there is almost everything we need for life. Food is the only thing that is not there. It must be delivered -- at least until the base creates its own hothouses and biocomplexes.

Of course, right now it is still difficult to imagine gardens on the moon earing grains. But indeed specialists recently performed an interesting experiment -- they planted plants in lunar soil. And the plants took root! Some have calculated that special plantations can grow up to one and a half kilograms of vegetables a day for every crew member.

But it is not just water, air, food, and construction materials that a lunar base can supply itself with. It can also provide itself with energy. Here is where the opinions of specialists part. Some consider nuclear energy, or maybe even thermonuclear energy, to be the most reliable form. Large reserves of fissionable elements are believed to exist on the moon. Other specialists lean toward solar batteries. True, they must be located at the poles, which the sun lights more or less constantly. Otherwise, the power stations would stand idle during the long lunar nights.

There are also more exotic projects. The use of thermocouples, for example. On Earth, it is difficult to obtain the necessary temperature difference between the cold junction and the hot junction. But on the moon, the temperature gradient can be as much as 300 degrees -- which is sufficient for effective operation.

About lighting, there is apparently no need to worry. Near a natural "lantern" -- our Earth -- crews on the moon will work in conditions similar to the white nights that the peoples of the north are familiar with.

The first specific projects involving lunar laboratories appeared about 20 years ago. True, the engineers and designers then were characterized by an excessive optimism. Now they prefer not to rush -- they are painstakingly working through the details of the lunar program.

One of the details names the address of the future landing site -- the western margin of Oceanus Procellarum. Here it is easier to deliver freight from Earth: here, it is believed, are rich deposits of ilmenite. The use of a new generation of unmanned near-lunar probes is planned for pinpointing the spot, or maybe ever suggesting a more convenient one. They are scheduled to launch in the early '90s.

Then, unmanned lunar rovers will take engineering measurements. And, finally, the first scouts will disembark -- four crew members on two all-terrain vehicles. Within 30 days the landing party must choose the exact spot for the first residential module. Construction workers, engineers, and researchers will arrive on the moon after unmanned vehicles have delivered everything that is needed. Eight flights are planned for that. And only on the ninth will the station's basic staff arrive. The systematic work will begin.

The development of the moon is a grandiose project with which man can enter the third millennium. His fate depends, in large part, on whether the planet will be able to unite its efforts in the peaceful development of space. The Soviet Union has called for this at the state level. A letter our government sent to the secretary-general of the UN, J. Perez de Cuellar, set forth a step-by-step program for practical, joint operations up to the year 2000. It laid the scientific-and-technical, organizational, and material foundations "for the transition as early as the first decade of the twenty-first century to the practical development and use of the moon, which includes its role as a base for flights to the other planets."

13227
CSO: 1866/52

EXPERIMENT PROGRAM OF PROJECT PHOBOS

Moscow SOVREMENNYYE DOSTIZHENIYA KOSMONAVTIKI (NOVOYE V ZHIZNI, NAUKE, TEKHNIKE: SERIYA KOSMONAVTIKA, ASTRONOMIYA) in Russian No 12, Dec 86 pp 44-64

[Article by T.K. Breus, candidate of physical-mathematical sciences: "Mars: Research Results and Prospects"]

[Excerpts] Two spacecraft will take off from the Baykonur Space-Launch Complex a few days apart in July 1988 (fig 1). First they will achieve the orbit of an artifical earth satellite and will be guided toward Mars right from there (fig 2). The flight will last about 200 days. The distance between Earth and Mars as of the moment of arrival will equal 180 million km. In approaching the planet, the spacecraft will change to a strongly prolate elliptical orbit positioned above the Martian equator. The extreme points of the orbit (fig 3) will be a few thousand and a few tens of thousands of kilometers, respectively, from the surface of Mars (orbit 1). Then the orbit's "perigee" will be increased to 9700 km (orbit 2).

The spacecraft will spend about 60 days in interim elliptical orbits. After this they will change to a circular orbit with a period of rotation of 8 h (orbit 3). The spacecraft will be in this orbit from 35 to 140 days. From here the spacecraft will begin "hunting" for Phobos and will gradually draw near it in order to study it at various angles at various distances with maximum resolution. Ultimately the orbit will become circular and synchronous with a 9400 km pericenter. It is precisely in this orbit that its satellite Phobos--one of the principal targets of the space mission--revolves around Mars. Hence the name of "Phobos" for the project.

The flight program calls for making a high-resolution television survey of the surface of Mars. Producing a temperature map of the surface of Mars, studying the diurnal and seasonal dynamics of temperature conditions, measuring the thermal inertia of the soil, and searching for permafrost regions, as well as sections of the emanation of endogenous (internal) heat, will be the objectives of radiometric and photometric measurements. The obtainment of data on the mineralogical composition of the planet's surface is planned.

The recording of Mars's gamma emission from on board the Mars-5 unmanned interplanetary station in 1974 made it possible for the first time to determine the nature of Martian rocks over an extensive area of the planet's

equatorial zone. The goal of this new experiment will be to determine the content of the principal rock-forming elements--magnesium, aluminum, sulfur, iron, etc.--and of natural radioactive elements--uranium, thorium and potassium. These data will make it possible to explain the nature of the rocks, their chemical composition, and, consequently, the degree of differentiation of the rocks in the process of their formation. Information on the concentration of uranium, thorium and potassium can be used also for studying the thermal history of Mars.

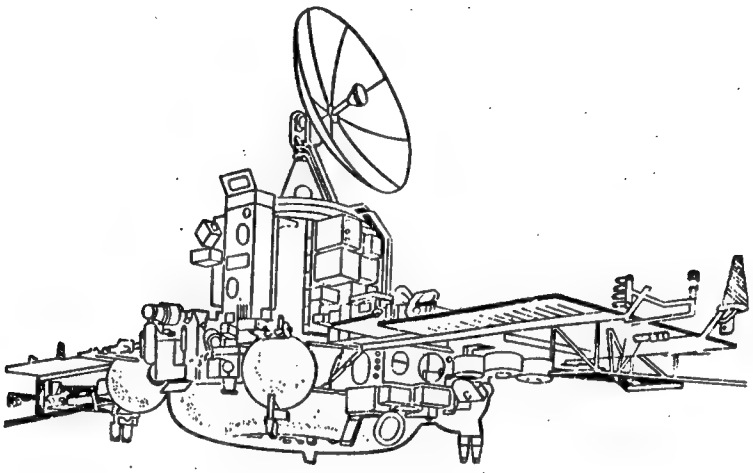


Figure 1. External Appearance of Phobos AMS [Unmanned Interplanetary Station]

The project calls for a series of experiments in studying the atmosphere and ionosphere of Mars. Measurement of vertical distributions of the concentration of ozone, water vapor, molecular oxygen and dust; of vertical temperature and pressure profiles; of seasonal, diurnal and local variations in atmospheric parameters; and of the ratio of deuterium to hydrogen is planned in particular. The measurement technique is based on recording the spectrum of solar radiation having passed through the atmosphere of Mars as the spacecraft approaches the planet's shadow and leaves it (fig 4).

Simultaneous measurements of the vertical profile of ozone, water vapor, temperature and pressure will provide complete and exhaustive information on the photochemistry of the atmosphere of Mars, will eliminate the existing uncertainty in photochemical models, and will be a verification of the self-consistency of these models. The principal reasons for the variability of individual components will be revealed, and, possibly, it will be possible to obtain new data on reserves of water on Mars and on its vertical and horizontal transfer.

Measurements of molecular oxygen and carbon dioxide will provide important information on the dynamics of gas exchange between the atmosphere and polar caps and on the reasons for the origin of dust storms.

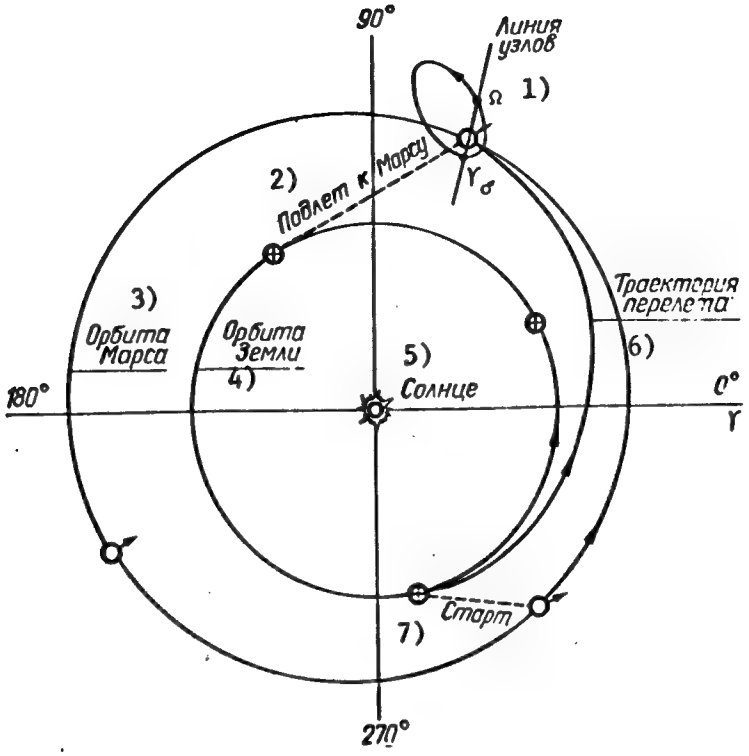


Figure 2. Diagram of Flight of Phobos AMS Along Earth-Mars Route

Key:

1. Nodal line
2. Flight to Mars
3. Orbit of Mars
4. Orbit of Earth
5. Sun
6. Flight path
7. Launch

Determination of the ratio of deuterium to hydrogen will shed light on the planet's past and explain the reason for the disappearance of liquid water on the planet.

It has been proposed to conduct studies of Mars's ionosphere by means of the pulsed radiosonde method. The principal goal of the experiment is to study the structure of the so-called ionopause--the sharp upper boundary of the ionosphere--and the altitude distribution of electron concentration under various conditions of illumination by the sun.

Of course, the concentration of charged particles in the ionosphere (of any planet, including Mars) first increases with altitude, reaching its maximum, and then decreases. Therefore, corresponding to each altitude is its so-called plasma frequency, which depends on the concentration of electrons and determines the conditions for the propagation of electromagnetic radiation in the ionosphere. If the frequency of a radio signal encountering a layer of

ionospheric plasma is lower than the natural plasma frequency, then the signal is echoed. If it is higher, then it passes through this layer.

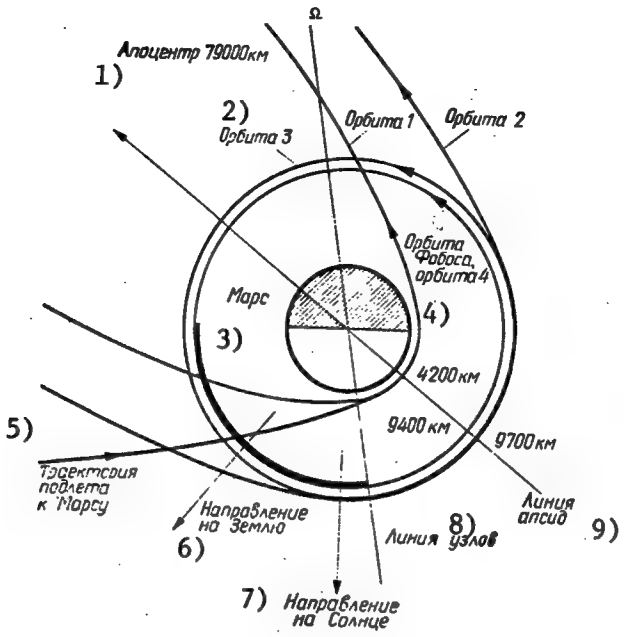


Figure 3. Orbit of Phobos AMS Around Mars

Key:

1. Apofocus
2. Orbit 3
3. Mars
4. Orbit of Phobos, orbit 4
5. Flight path to Mars
6. Direction to Earth
7. Direction to Sun
8. Nodal line
9. Line of apsides

With changing of the frequency of radio pulses sent into the ionosphere, each of them will be propagated in it up to the altitude at which its frequency is equal to the plasma frequency. Thus, in sounding the ionosphere by a set of radio pulses with an increasing frequency, they will be echoed successively from various altitude layers of the ionosphere characterized by their own plasma frequency equal to the frequency of a specific pulse. Of course, this will occur until the concentration begins to drop, i.e., right to the ionization maximum. By measuring the propagation time for each pulse in turn to the reflecting layer and back, it is possible to obtain data on the distribution of the plasma frequency by altitude, and, consequently, on the electron concentration.

The operation of ground ionosondes is based on this method of study.

It is possible to place a sonde on an artificial satellite and sound the Earth's ionosphere from above. An experiment like this was performed, for example, on board the Intercosmos-19. But studies of the ionospheres of other planets in this way have not been made hitherto.

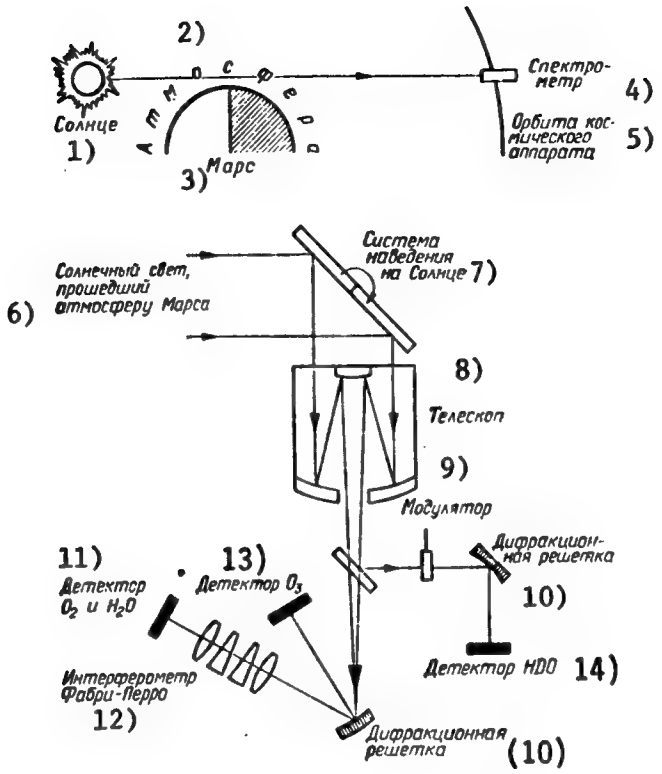


Figure 4. Diagram of Performance of Experiment in Studying Chemical Composition of Martian Atmosphere

Key:

1. Sun
2. Atmosphere
3. Mars
4. Spectrometer
5. Orbit of spacecraft
6. Sun's light passing through atmosphere of Mars
7. System for aiming at sun
8. Telescope
9. Modulator
10. Diffraction grating
11. O_2 and H_2O detector
12. Fabry-Perot interferometer
13. O_3 detector
14. HDO detector

In the Phobos Project the altitude distribution of the electron concentration in the ionosphere of Mars will be studied by the method of sounding it by means of radio pulses of increasing frequency, from on board a spacecraft while it is moving in orbit around the planet.

A study of the Martian ionosphere is important in and of itself. In addition, it will make it possible to clarify the question of the nature of the magnetic field of Mars. Of course, interplanetary space is filled with the solar wind--with streams of plasma continuously emitted by the sun. And all the planets are immersed, as it were, in this plasma, which is essentially the

medium of their existence. The solar wind is exceedingly rarefied: No more than a few dozen particles are contained in one cubic centimeter, and these particles do not collide even with one another. The magnetic field of the solar wind is also very weak--it equals a total of just ten-thousandths of the strength of the earth's magnetic field on its surface. Nevertheless, the planets react noticeably to the solar wind. Moreover, the interaction of their atmospheres and ionospheres and of the natural magnetic field with the streams of solar plasma constitutes a very important and quite particular field of planetary physics.

For example, when the solar wind swoops down on the earth's magnetic field, the field stops it rather far from the earth's surface, at a subsolar point at a distance of approximately 60,000 km. Furthermore, the magnetic field of our planet is contracted on the sunlit side, and the magnetic lines of force are "swept" from the day side to the night. As a result, a cometlike space forms--the magnetosphere, filled with the earth's natural magnetic field. The solar wind does not directly penetrate this space. Thus, the earth's ionosphere is protected from streams of solar plasma and behaves basically independently of it. Our star serves as the principal source of the atmosphere's ionization. Consequently, as the sun sets the terrestrial ionosphere will relax. The region above the principal ionization maximum begins to shrink, and the value of the concentration at the maximum and its altitude are reduced.

The opposite picture is observed on Venus. Since this planet does not have an appreciable natural magnetic field, two plasmas--solar and planetary (i.e., ionospheric)--intensely interact with one another. Under the effect of the dynamic pressure of the solar wind stream, the ionosphere of Venus is "contracted" on the sunlit side and has a sharp upper boundary--the so-called ionopause. The pressure of the solar wind stream is weaker on the flanks and the ionosphere bulges--its upper boundary draws away from the planet and is raised higher and higher as the sun sets or the terminator separating night and day is neared.

But what happens with Mars? Does it have its own magnetic field?

An analysis of the results of measurements made by means of Soviet unmanned stations (there were no corresponding instruments at all on American spacecraft) made it possible to come to the conclusion that Mars does have its own magnetic field, but a very weak one. Apparently it is tens of thousands of times weaker than that of the earth. Therefore it is not yet clear whether it can serve as the same shield from the solar wind as the Earth's field does for our planet.

If Mars, as the Earth, is protected from the solar wind by a magnetic field, then its upper ionosphere must behave the same (or in a similar manner) as the Earth's. If the ionosphere of Mars is like that of Venus, then this means that its magnetic field is so weak that the solar wind does not "feel" its presence.

Meanwhile there are certain hypotheses concerning how planetary magnetic fields form and how they are related to the internal structure of the planets.

In particular, it follows from the theory that a planet having its own magnetic field must rotate rather rapidly and have a liquid core.

The close values of the mean densities of Venus, Earth and Mars served as the basis for the development of similar models of their internal structure. In this case the absence of its own magnetic field for Venus could be explained by its slow rotation (Venus's period of rotation equals approximately 243 days). On Mars a day lasts 24 h 30 min 35 s. In addition, its magnetic field, as already mentioned, is weak. Is this not a proof of the essential difference of the internal structure of Mars? According to some representations, the mass of its liquid core does not exceed approximately one percent of the planet's total mass. Scientists are hoping that the radar sounding of the ionosphere of Mars called for by the Phobos Project will help to answer this question.

The project includes a plasma complex which, in the flight to the planet and during orbital motion of the spacecraft around Mars, will provide information on the features of the flow of the solar wind around it and on the characteristics of the magnetosphere.

The first studies of the magnetosphere and of its interaction with the solar wind were made in 1971-1974 from on board the Mars artificial satellites--the Mars-2, Mars-3 and Mars-5. A shock wave was detected, and the trail of the magnetosphere, the shape and dimensions of the magnetosphere were determined, indications were gotten of the existence of a weak natural magnetic field, and a hot plasma of planetary origin was discovered both in the magnetosphere itself and in the stream flowing around it. The basis of today's ideas concerning the outer envelopes of Mars and processes taking place in the circumplanetary space was formed as the result of analyzing these data.

However, since the orbits of these satellites conformed poorly to the objectives of research on the planet's magnetosphere, and because of the inadequacy of the capabilities, both in terms of informativeness and makeup, of the scientific equipment on board the Mars-2, Mars-3, Mars-4 and Mars-5, these ideas are of a very limited nature. At the same time it is obvious that by virtue of the weakness of the planet's own magnetic field, the interaction of the solar wind with the upper atmosphere and ionosphere of Mars must play a major, if not decisive, role in magnetospheric processes.

Because of the absence, in previous expeditions of spacecraft to Mars, of instruments which measure plasma parameters over wide ranges of angles and energy, there are no data both on the ion composition and characteristics of various kinds of ions, knowledge of which is especially important for a planet which apparently has a combined type of interaction with the solar wind.

It has also become clear in recent years that considerable progress can be achieved in understanding the physical processes taking place in the magnetospheres of planets by just having information on the distribution functions of charged particles.

The Phobos Project calls for studies of the mass composition of ions in the magnetosphere of Mars, determination of the moments of the distribution

function for ions and electrons in the planet's surroundings, and study of the structural formations and dynamics of its magnetosphere. This will be the first experiment making it possible to obtain a three-dimensional distribution function for electrons and principal types of ions in the surroundings of Mars and in the solar wind.

The experimental technique represents a further development of the mass spectrometer studies performed in the Soviet-Swedish PROMIKS experiments. Electrons will be selected by means of electrostatic analyzers and magnetic deflection systems.

One principal diagnostic method of studying a plasma, including a cosmic plasma, is the study of plasma waves. In a collisionless plasma, wave phenomena determine the nature of the interaction of its particles. It is precisely studies of plasma oscillations in combination with measurements of the magnetic field and characteristics of the plasma which make it possible to ensure reliable identification of processes in the solar wind stream flowing around a planet and in the magnetospheres of planets. Moreover, studies of plasma waves make it possible in a number of instances to isolate new phenomena which it has not been possible to detect by other methods of measuring. This feature of wave diagnosis was demonstrated well, in particular, in studies performed near Earth, Venus, Jupiter and Saturn.

One capability of wave diagnosis discovered in studying planets with a developed atmosphere is studying the influence of the capture by the plasma stream of planetary ions which form from atoms of the upper atmosphere in photoionization. These processes can play an important role in formation of the shock wave and magnetosphere of Mars.

The wave experiment planned has two important features. First of all, it will be possible to measure the electric component of plasma waves in the extremely-low-frequency band, where these waves, as demonstrated by measurements by means of the Prognoz-8 satellite, play a decisive role in the energetics of processes in the plasma. In addition, a combined diagnostic system will be used in the experiment, utilizing measurements of the electric field and variations of the plasma stream, which will make possible reliable identification of types of oscillations. Experiments of this kind have not been performed previously near Mars.

Magnetometric measurements will be made by means of two ferromagnetic probe magnetometers.

For the purpose of making an integrated investigation of Phobos, the flight program calls for the spacecraft to come a few dozen meters close to its surface and to conduct investigations while "hedgehopping" (fig 5). By controlling its position by means of low-thrust engines, the spacecraft will almost hover over the surface of the Martian satellite. Its travel speed will not exceed 2 m/s. Studies will be made of the elemental and isotope composition of Phobos's soil during this time (fig 6). A small section of its surface measuring a total of 1 mm^2 in area will be exposed to a laser beam. Because of its high focusing precision, made possible by an on-board range finder, the energy density at the exposed spot will equal more than 10 mW.

With this, the dust covering the surface in a thin layer will instantly vaporize. A special mass spectrometer will determine the composition of the particles thrown in the direction of the spacecraft in the process, for the time they travel the distance to the spacecraft. It is planned to register approximately a million particles during the course of one measuring cycle. "Even the idea of using such a technique is so innovative that it blows your mind," declared one American scientist of the planetologists acquainted with Soviet developments.

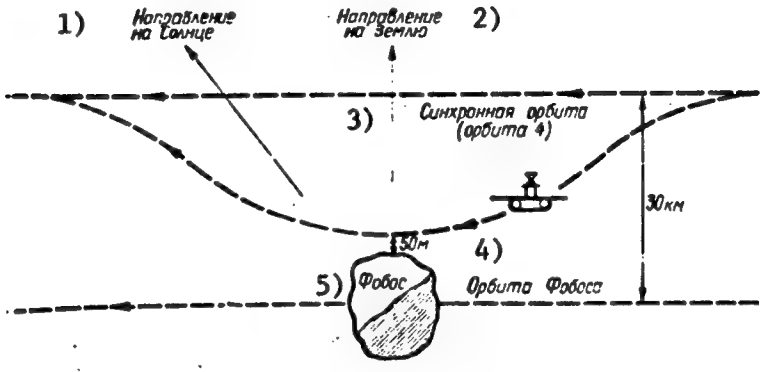


Figure 5. Diagram of Flight of Spacecraft Over Surface of Phobos

Key:

1. Direction to sun
2. Direction to earth
3. Synchronous orbit (orbit 4)
4. Orbit of Phobos
5. Phobos

The procedure of another active experiment which it is planned to perform is based on the injection of a stream of krypton ions by means of a plasma gun. The secondary particles ejected by it from the surface layer of soil will be analyzed in terms of their mass spectra recorded on board the spacecraft (fig 7).

The television survey of Phobos will be performed in three spectral channels simultaneously. This will make it possible then to synthesize from the black-and-white images color photographs on which it will be possible to distinguish surface details with linear dimensions greater than 6 cm.

Spectrometry of the photographed sections in 14 regions of the spectrum will be performed simultaneously.

The memory included in the video spectrometry system will make it possible to record 1100 full frames (three television frames and a spectrogram) with their subsequent readout for transmission to the earth through a radio channel.

By changing the direction of the instruments' field of view by means of a rotating mirror, it will be possible to make both vertical and panoramic photographs and to obtain images of Phobos against the star background. The latter fact is important for solving flight navigation problems. The images and spectrograms of the surface transmitted to the earth will make it possible

to perform a physical mapping of Phobos; to make topographic, spectral-brightness, structural-morphological and other maps of it; and to accomplish the coordinate referencing of measurements made by other instruments.

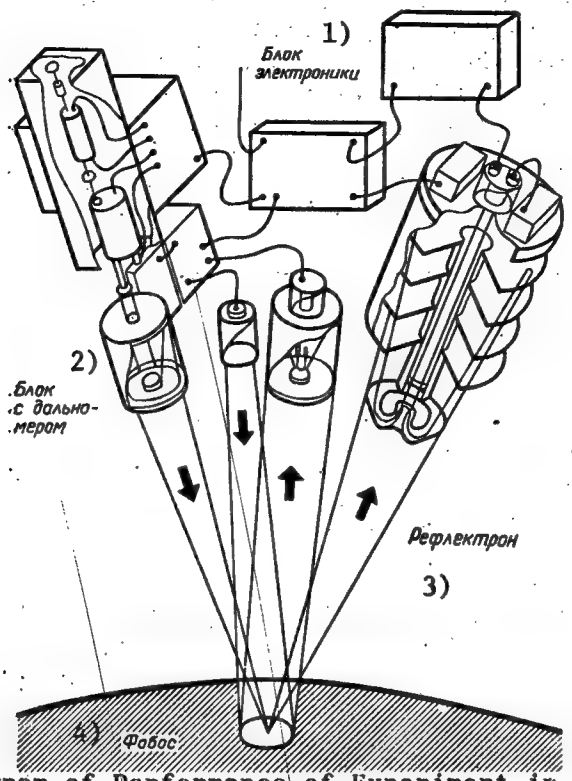


Figure 6. Diagram of Performance of Experiment in Mass-Spectrometry Analysis of Composition of Soil

Key:

1. Electronics
2. Unit with range finder
3. Reflectron

The relief, surface structure and electrophysical characteristics of the soil will also be studied by the method of radiosonde observation from on board the spacecraft when it drifts at low altitude over the surface of Phobos.

An experiment is planned in studying the thermophysical and reflection properties of the surface of Phobos in the infrared and visible region and in studying its mineralogical composition on the basis of spectra in the near infrared region. One principal feature of the experiment is its integrated nature. Measurements will be made simultaneously by a combination radiometer (fig 8) having angular resolution of 30', a photometer having angular resolution of 16', and an infrared spectrometer having angular resolution of 12'. The spectral subbands are divided into 10 parts for the photometer, 128 for the spectrometer, and 6 for the radiometer. The scanning method of measuring is planned for the spectrometer.

After the spacecraft has come to a distance of a few dozen meters from Phobos, the landing probe will be separated from it--a long-lived unmanned station which will begin slowly to "drop" onto the surface. The relative closing

rate of the station and Phobos will be a few meters per second. In order for the landing to be oriented, the station will spin on its longitudinal axis after separating from the spacecraft. After the landing, it will be actively secured to the surface of Phobos by means of a probe sunk by means of a pyrotechnic charge. After the station has been secured, the elements of its structure will be opened and the solar batteries and sensors of the scientific equipment will be aimed at the sun.

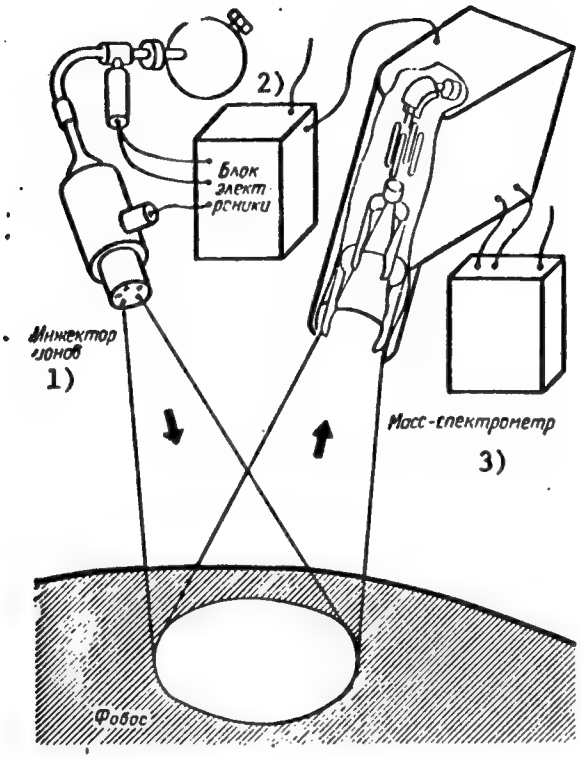


Figure 7. Diagram of Performance of Experiment in Mass Analysis of Secondary Ions

Key:

1. Ion injector
2. Electronics
3. Mass spectrometer
4. Phobos

The principal objective of the long-lived unmanned station (fig 9) is to conduct experiments on the surface of Phobos which require longterm measurments. These include, for example, studies of the parameters of its motion in orbit.

Since the Mars satellite has a low (as compared with spacecraft) surface-mass ratio, the influence of gravitational forces on its motion is negligibly minor. The irregular nature of the distribution of mass inside Mars also exerts a very minor influence on the orbit of Phobos. The landing of the probe on the surface of Phobos and the reception by the method of global radio interferometry of radio signals transmitted by the on-board transmitter will

make it possible to make unique studies of the mechanics of the solar system and to refine a number of its quantities.

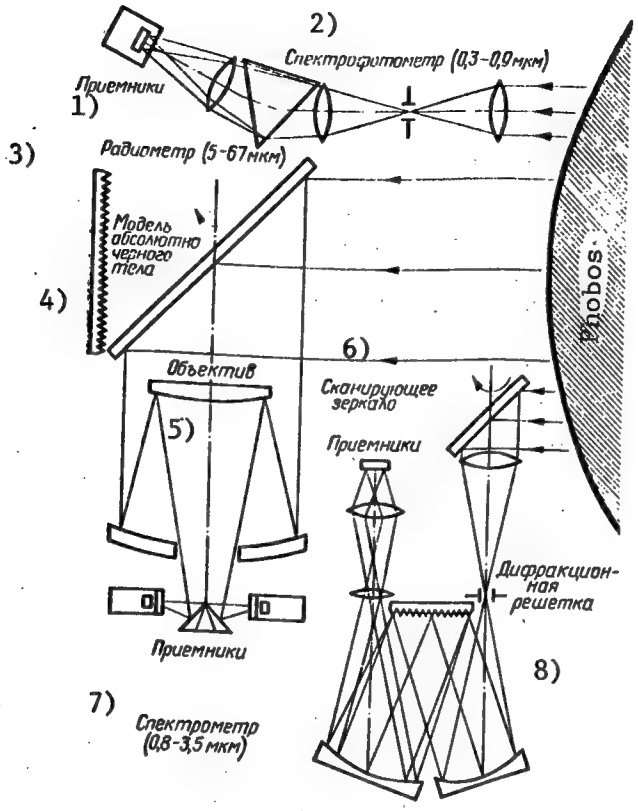


Figure 8. Diagram of Performance of Experiments in Radiometry (Infrared) and Spectral Measurements

Key:

1. Receivers
2. Spectrophotometer (0.3 to 0.9 micrometer)
3. Radiometer (5 - 67 μm)
4. Model of absolute blackbody
5. Lens
6. Scanning mirror
7. Spectrometer (0.8 - 3.5 μm)
8. Diffraction grating

The radio signals will be received by 70-meter antennas in Yevpatoriya and Ussuriysk and a 64-meter antenna in the Moscow suburbs. In addition, in order to receive telemetric information from the unmanned station outside its area of coverage in the territory of the USSR, and to determine the angular position of the transmitter relative to quasars, it has been proposed to involve in the measurements radio telescopes located in West Europe, North and South America, the southern part of Africa and Australia.

Measurements of distance are to provide the principal information for experiments in celestial mechanics. The expected accuracy of these measurements is about 5 m. The radio signals of the orbital spacecraft will be received simultaneously with the signals of the unmanned station. This is necessary in order to take into account the influence of the medium on signal propagation in measurements of distance.

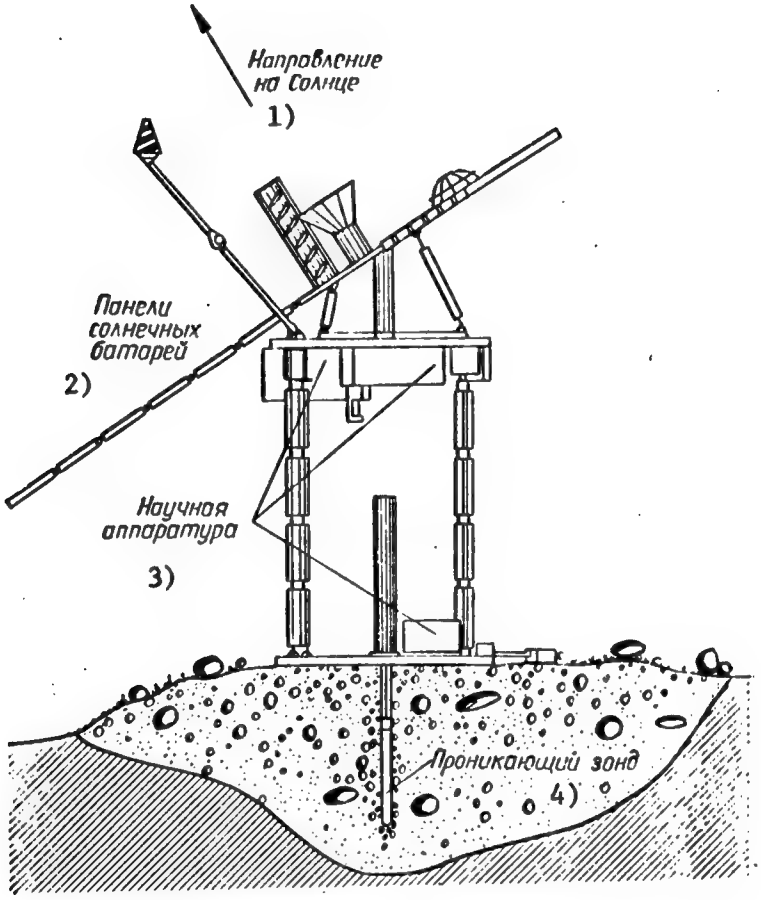


Figure 9. Long-Lived Unmanned Station

Key:

1. Direction to sun
2. Solar battery panels
3. Scientific equipment
4. Penetrating probe

Studies of the libration of Phobos also require a long time. They will be performed in independent measurements of the angular position of the sun by means of an optical sensor and radio interferometry measurements from the signals of two transmitters spaced apart on the surface (it is assumed that each spacecraft in closing with Phobos will drop onto it its own long-lived unmanned station).

And, finally, one more longterm experiment--the recording by means of a seismometer of the noise caused by the gravitational field of Mars and thermal expansion of the rocks of Phobos as it changes from day to night, and by the falling of meteorites.

Another group of experiments which will be performed by the unmanned station includes studies of the elemental composition of the surface layer, its structure and physicomechanical characteristics. The principal amount of information on the elemental composition will be obtained from on board the oribtal spacecraft by remote methods--by laser sounding. Direct measurements in an independent station are important for the purpose of calibration and facilitation of the interpretation of the data of remote measurements. A unit for measuring acceleration in collision with the surface, an x-ray fluorescent emission spectrometer for determining the chemical composition of the surface layer of soil, a penetrometer for studying its physicomechanical characteristics, and a television system are being installed on the landing vehicle for this purpose.

Still another landing probe (fig 10) will be able to move along the surface of Phobos. After landing and settling down on the surface, it will be changed to its working position by means of the whiskers of the orientation device. Then scientific measurements will be made. The information will be transmitted to the earth through a radio channel. The operating cycle concludes with the vehicle's jumping a distance of 20 m by means of a pusher device. After settling down, the vehicle is ready to repeat the operating cycle. One principal instrument of this landing vehicle will be a unit for studying the supporting power, adhesion, compressibility and viscosity of the soil.

The Phobos Project also calls for a major solar research program.

The interest of scientists in studying physical conditions in the sun is due not only to the fact that it is the closest typical star to us (consequently, by observing it, it is possible to obtain information on processes in stars) and is an enormous natural laboratory for plasma research. Solar radiation flux to a great extent determines the properties of interplanetary space and physical conditions on the surface of planets and in their atmospheres.

Extra-atmospheric studies of the sun have been performed since the launching of the very first spacecraft. However, until recently they were performed principally from the orbit of the earth, i.e., practically from a single point in space. Now the problem has arisen and ways are being sought of studying the sun simultaneously from several points. The Phobos Project presents definite possibilities in this respect.

After launching, as the spacecraft gets farther from the earth, the angle at the sun between the line to the spacecraft and the earth will increase from 0 deg to values close to 180 deg. In observations of the sun simultaneously from on board a spacecraft, from the earth and near-earth satellites, a unique opportunity is opened up for reconstructing the 3-dimensional (stereoscopic) structure of the chromosphere and corona (solar tomography). When the spacecraft achieves the orbit of an artificial Mars satellite it will be

possible to observe by means of its on-board antenna processes in the sun which are not visible at this time from the earth. Such a method of observation opens up, in particular, prospects of reliable forecasting of manifestations of solar activity.

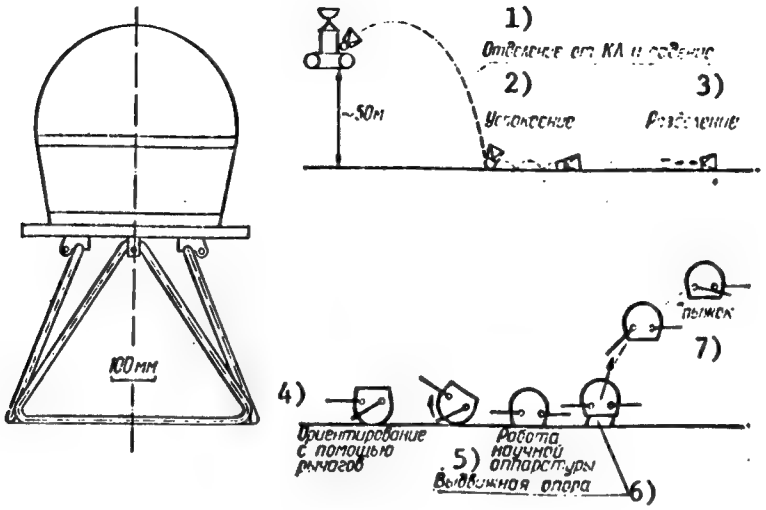


Figure 10. Traveling Landing Probe (Left--General View, Right--Operation Diagram)

Key:

1. Separation from spacecraft and dropping
2. Settling down
3. Separation
4. Orientation by means of levers
5. Operation of scientific equipment
6. Extensible support
7. Hop

Studies of the sun's electromagnetic radiation will be made over a wide frequency range in the Phobos Project---from the soft ultraviolet to hard gamma radiation. One objective of the research will be, in particular, obtaining images of the sun in the soft and ultrasoft x-ray and visible regions; studying the evolution of large-scale structures and obtaining stereoscopic pictures of their structure; determining physical conditions in flares and active regions, coronal holes and bright points; and clarification of the mechanism for the transformation of magnetic energy into heating of the coronal plasma and its turbulent and ordered motion, and the acceleration of electrons.

Studies will be made by means of a telescope-coronograph whose sensor unit has three optical channels. Each of them contains focusing optics, spectral filters and an electronic system based on solid-state matrix radiation detectors.

Observations of the sun's electromagnetic radiation will be supplemented to a considerable extent by information on corpuscular flux--the solar wind, fast solar cosmic rays formed at the time of solar flares, the magnetic field and wave processes in interplanetary space.

Spectrometric studies of the energy, mass and charge composition of the solar wind are planned. A special high-sensitivity instrument which will be able to accumulate data over a long time is being installed on board the spacecraft for this purpose. Then these data will be analyzed by the on-board computer, which calculates the masses and charges of registered ions of the solar wind. The data obtained are compressed and transmitted to the earth through telemetry channels.

A spectrometer will be used for the purpose of studying the distributions of such principal components of the solar wind as protons and alpha particles. It will measure the flux density, the overall velocity, the temperature and its anisotropy (non-identity in different directions).

A special monitoring instrument will monitor the sun's activity and form a signal in response to the x-radiation of a solar flare. It will issue a command for high-precision guidance of the spacecraft toward the sun and for turning on the equipment of the solar complex. The analysis of the data obtained from this instrument will provide valuable information on possible forerunners of solar flares.

Particular attention has been paid in recent years in the problem of solar flares to studying so-called nuclear gamma lines. Unlike research done previously, a fundamentally new technique for recording gamma-ray bursts has been used for the first time in the Phobos Project for the purpose of considerably improving time and energy characteristics. The expected recording rate is approximately one burst per 24-hour period. The good time and energy characteristics of the instrument will make it possible to study the periodicity and precise time structure of both solar and cosmic gamma-ray bursts.

Let us recall that gamma-ray bursts were detected for the first time only at the beginning of the 70's. The story of their discovery is as follows. Soon after the ban on nuclear blasts in the atmosphere, the Americans set up a patrol monitoring service utilizing Vela satellites. Of course, a nuclear explosion is accompanied by a powerful gamma-radiation pulse. And the detectors installed on the patrol satellites recorded bursts of this radiation. Soon, however, it was revealed that these bursts were of cosmic origin. Their brightness, sometimes surpassing by a factor of thousands the brightness of the strongest of known stationary sources, was astonishing. And the duration of the bursts of radiation was only dozens of seconds.

Only about 80 bursts were recorded in the first eight years of observation by means of satellites and interplanetary stations since the moment of discovery. Furthermore, their nature remained absolutely unclear. And then 150 gamma-ray bursts were recorded at once in the "Konus" [Cone] experiment which was performed on the Venera-11 and Venera-12. The bursts were recorded simultaneously by the equipment of American and West European spacecraft. But the sensitivity of the equipment used in the "Konus" experiment was 30 times greater than that of any other. The combined analysis of the results of all observations made it possible to provide precision of fractions of a minute of angle in determination of the coordinates of radiation sources. The most

surprising thing was the absence of any bright stars at all at these coordinates.

The high sensitivity of the equipment plus the excellent spectral resolution made it possible for Soviet scientists to explain the nature of the sources of cosmic gamma-ray bursts. They are most likely neutron stars with superstrong magnetic fields.

As already mentioned, the studies of gamma-ray bursts called for by the Phobos Project differ essentially from all previous ones and will make it possible to solve important problems associated with studying them.

Still another interesting experiment involving study of the sun has the purpose of investigating the structure and dynamics of its internal constitution. The experiment is based on longterm continuous high-precision measurement of the intensity of solar radiation in narrow spectral channels. The instrument contains three solar photometers having interference filters, and a sun position detector. Silicon diodes are used as radiation detectors.

It is planned to make observations of cosmic gamma-ray bursts and to implement the "solar" program in the Phobos Project in cooperation with the program for investigation of the sun by means of the West European Ulysses extra-ecliptic probe.

The long Phobos-Ulysses baseline, equal to approximately .1 AU, and the presence of a third observation "point" in the form of the Soviet Granat astronomical satellite, which is to be operating in near-earth orbit at this time, will make possible accuracy on the order of 10" in the localization of sources of gamma-ray bursts.

Institutions, scientists and specialists from Austria, Bulgaria, Hungary, the German Democratic Republic, Poland, the Soviet Union, Finland, France, the Federal Republic of Germany, Czechoslovakia, Switzerland, Sweden and the European Space Agency are participating in development of the scientific program of the Phobos Project, the development of the equipment complex and the performance of experiments.

8831
CSO: 1866/40

COMMENTARY ON PHOBOS MISSION EXPERIMENTS

Moscow MOSKOVSKAYA PRAVDA in Russian 5 Nov 86 p 3

[Article by Yu. Gordeyev: "An Odyssey Called 'Phobos'"; first paragraph in boldface in source]

[Text] The achievement of a project involving manned flight to Mars would, undoubtedly, make for an outstanding advance that would find wide applications on Earth. Such a flight, however, cannot be considered a mission for today or even tomorrow: numerous studies and engineering developments as well as flight-trajectory analysis are needed before people will be ready to set out for Mars. And here an important role is assigned to the unmanned vehicles, writes the APN correspondent.

A grandiose space odyssey has been conceived by Soviet scientists. Its principal feature is the complexity of the research that is planned. In addition to Mars itself, the project involves a broad study of Mars' natural satellites, Phobos and Deimos, as well as experiments along the flight's trajectory.

The overall length of the mission is calculated to be 460 days. It will begin in July 1988, when two spacecraft are launched from the Baykonur cosmodrome several days apart. They will first go into the orbit of an artificial Earth satellite, and then they will head to Mars from there. The duration of the flight will be 200 days. When they reach Mars, the distance between Earth and Mars will be 180 million kilometers.

Upon approaching the planet, the spacecraft will go into a highly elliptical orbit over the Martian equator. The perigee and apogee of the orbit will be several hundred kilometers and tens of thousands of kilometers, respectively, from the surface of Mars. After that, the perigee will be increased to 9,700 kilometers.

The spacecraft will spend 60 days in intermediate elliptical orbits. A video survey of the surface of Mars will be done from these orbits. On the photographs that are then sent by radio channel back to Earth, one will be able to distinguish details of the surface that are several kilometers in size.

In addition, the surface of Mars will be studied in the infrared and gamma ranges. French scientists are taking part in this operation. They are developing an infrared spectrometer ISM. It will be used to study the thermophysical and reflective properties of the Martian surface and the diurnal and seasonal dynamics of its temperatures and to search for sites at which interior heat is released and for Martian permafrost regions.

Simultaneously, Soviet instruments will determine the contents of the principal rock-forming and natural radioactive elements in the surface layer of Mars.

Soviet and French scientists have also planned joint experiments that will study the planet's atmosphere. For this purpose, the astronomy bureau of France's National Center for Scientific Research is developing an instrument called "Auguste." The instrument will record the change in the spectrum of solar radiation as it passes through the Martian atmosphere. The aim of the experiment is to measure the vertical distributions of concentrations of ozone, water vapor, molecular oxygen, and dust. The lengthy duration of the observations will enable the determination of seasonal, diurnal, and local variations in atmospheric parameters.

After completing their work in the intermediate elliptical orbits, the spacecraft will go into a circular orbit with an orbital period of 8 hours. The spacecraft will be in this orbit for between 35 and 140 days, gradually nearing Phobos. As a result, the orbit will become a circular, synchronous orbit, with a pericenter of 9,400 kilometers. Circling Mars in this very orbit is its natural satellite Phobos -- one of the primary targets of mission. Hence the name of the project, "Phobos."

The multifaceted, in-flight study of Phobos calls for the approach of the spacecraft to within several dozens of meters of the surface and "grazing" studies. Controlling its position with low-thrust engines, the craft will practically hover above the surface of the Martian satellite. The rate of motion will not exceed 2 meters a second. At this time, a video survey of Phobos' surface is planned. It will be done on three spectral channels. This will make it possible to later synthesize from the black-and-white images color photographs in which it will be possible to distinguish details of the surface with linear dimensions of more than 6 centimeters. You will recall that the American "Viking-1" photographed Phobos from a distance of nearly 300 kilometers, and the resolution of the photographs was in the dozens of meters.

When the spacecraft is at its closest point to Phobos, a small plot of the surface only a millimeter square will be illuminated by the beam of an on-board laser of Soviet design. Thanks to the high precision of the beam focus, which is due to an on-board electronic range-finder, the power density in the illuminated spot will be on the order of ten million watts. The dust covering the surface in a thin layer and matching the composition of the bedrock will vaporize in explosion-like bursts. A special mass-spectrometer will determine the composition of the particles thrown up by the explosion from their time of flight from the surface to the spacecraft.

The technique of another active experiment is based on the use of the French instrument "Aspek," developed by the Orleans Laboratory of Environmental Physics and Chemistry of the National Center for Scientific Research. The instrument is a plasma gun that will irradiate on the order of 100 square meters of Phobos' surface with a stream of krypton ions. The secondary particles it dislodges from the soil will be analyzed on board the spacecraft by a special mass-analyzer. This will enable the study of the composition of the surface layer of Phobos.

During the flight over the surface of Phobos, active methods will be used to analyze the soil at approximately 100 sites.

The French-developed infrared spectrometer (ISM) that was mentioned above will be used not only for the study of Mars, but also for the study of the thermophysical and reflective properties of the surface of the Martian satellite.

In addition to remote studies, the project also calls for direct-contact studies of Phobos with a long-lived, autonomous lander.

A large-scale program of solar studies is also planned. They will be done during the flight to Mars as well as during the orbits around it.

After launch, the angle at the sun between the direction to the spacecraft and the direction to Earth will increase, in proportion to the distance of the craft from the Earth, from zero degrees to values near 180 degrees. Simultaneous observations of the sun conducted from the spacecraft, from Earth, and from near-Earth satellites open the unique possibility of obtaining a three-dimensional (stereoscopic) picture of the structure of the sun's chromosphere and corona. When the spacecraft goes into the orbit of the Martian satellite, it will be able to observe, with its on-board equipment, processes on the sun that are not visible at that time from Earth. Such a method of observation widens, in particular, the prospects of reliably predicting solar activity. The French scientists are participating in the development of an instrument that will enable continuous, long-term, highly accurate measurement of the intensity of solar radiation in narrow spectral channels. It involves recording the solar fluctuations discovered by Soviet scientists.

Especial attention will be devoted to the study of cosmic gamma-ray bursts. The experiments that are planned will be an extension of the Soviet-French program involving gamma-ray astronomy, "Sneg," but they will be performed with more advanced instruments. In particular, an essentially new technique for recording gamma-ray bursts will be used for the first time ever.

Performance of the observations of gamma-ray bursts and completion of the "solar" program in project "Phobos" are planned in cooperation with a program of operation involving a western European probe outside the ecliptic plane. The enormous distance between these craft, roughly equal to one astronomical unit, and the presence of a third "point" of measurement in the form of the Soviet satellite "Granat," which at that time will be operating in a near-Earth orbit, will

assure that the locations of the gamma-ray bursts are established with an accuracy on the order of 10 seconds of arc.

In addition to the participants from the USSR and France, institutes, scientists, and specialists from Austria, Bulgaria, Hungary, the German Democratic Republic, Poland, Finland, the Federal Republic of Germany, Czechoslovakia, Switzerland, Sweden, and the European Space Agency are taking part in the formulation of the scientific program of project "Phobos," the development of the research equipment, and performance of the experiments.

13227
CSO: 1866/52

UDC 523.42

CATALOGUE OF CRATERS IN VENUSIAN NORTHERN HEMISPHERE BEARING EVIDENCE OF IMPACT ORIGIN

Moscow ASTRONOMICHESKIY VESTNIK in Russian Vol 21 No 1, Jan-Mar 87 (manuscript received 12 Jun 86) pp 26-36

[Article by I.M. Chernaya, V.P. Kryuchkov, A.T. Bazilevskiy, G.A. Burba, O.N. Rzhiga, G.M. Petrov, A.I. Sidorenko and Yu.P. Aleksandrov, Geochemistry and Analytical Chemistry Institute imeni V.I. Vernadskiy, USSR Academy of Sciences; Radio Engineering and Electronics Institute, USSR Academy of Sciences]

[Abstract] A table was prepared listing 146 impact craters on Venus. The tabulation is limited to those features which are well-expressed in the relief with a diameter $\geqslant 8$ km in the survey zone to the north of 30-35°N (survey zone area 115 million km^2). The principal morphological indicator of impact origin of craters is their similarity to morphologically fresh impact craters on the Earth, Moon, Mercury and Mars. The tabulated data include number of crater, its name, coordinates, type of surrounding terrain, crater diameter, morphological class and type, the spacecraft from which observed and zone from which image fragment was obtained. The numbering is in the sequence of a decrease in Venerographic latitude, or in the case of an identical latitude, in the sequence of an increase in longitude. The names are given in accordance with a resolution of the 19th IAU General Assembly. Six types of surrounding terrain are used. Crater diameter was measured with an accuracy of 1-2 km. The morphological class denotes the degree of morphological expression of the crater. Six morphological types of crater are assigned. Photographs of these six types are given. Figures 3; references 7: 6 Russian, 1 Western.

5303/8309
CSO: 1866/74

UDC 523.044

COMPUTING GAMMA QUANTA FLUX DENSITIES OVER VENUSIAN AND EARTH'S SURFACES

Moscow ASTRONOMICHESKIY VESTNIK in Russian Vol 21 No 1, Jan-Mar 87 (manuscript received 31 Jul 86) pp 37-46

[Article by Yu.A. Surkov and O.S. Manvelyan, Geochemistry and Analytical Chemistry Institute imeni V.I. Vernadskiy, USSR Academy of Sciences]

[Abstract] The dependence of the density flux of unscattered gamme quanta on height above the surfaces of Venus and Earth were computed. The areas from which a definite percentage of gamma quanta were "collected" were computed for each height. A similar study was made earlier for the Moon and Mars (Yu.A. Surkov, et al. KOSMICH. ISSLED., Vol 16 No 2, pp 301-306, 1978). This article gives data on the dependence of the flux density of gamma quanta on height and spatial resolution of the detector for planets with a higher atmospheric density. Among the relations determined were: height dependence of ratio of flux density of unscattered gamme quanta to the flux density at the surface for Venus and the Earth; fraction of flux density of unscattered gamma quanta as function of "viewed" area for different heights above Venusian surface and same above Earth's surface; dependence of area from which 90 percent of the gamma quanta are collected on density of atmospheric surface layer; height dependence of ratio of flux density of scattered and unscattered gamma quanta to density of corresponding fluxes at Venusian surface. These and other results make it possible to evaluate the optimal conditions for measuring gamma fields over the surface of the two planets. Such data are also needed for determining the elemental composition of rocks from the registered spectrum of characteristic gamma radiation. Figures 6; references 13: 10 Russian, 3 Western.

5303/8309
CSO: 1866/74

UDC 523.72:523.42

INFLUENCE OF EXTENDED NEUTRAL ATMOSPHERE ON INTERACTION BETWEEN SOLAR WIND AND NONMAGNETIC SOLAR SYSTEM BODIES. I. VENUS

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 25 No 1, Jan-Feb 87 (manuscript received 17 Oct 85) pp 124-132

[Article by T.K. Breus, A.M. Krymskiy and V.Ya. Mitnitskiy]

[Abstract] The flow of the solar wind around Venus was modeled numerically, taking into account the loading of the flow by heavy ions forming during photoionization of the neutral oxygen corona of that planet. It is shown that this effect can explain a number of aspects of interaction between the solar wind and the planet which until now have not been clear, such as the position of the bow shock, characteristics of the solar wind flow and the magnetic field behind the front. A study was made of this problem which included: quantitative evaluation of the loading effect, nature of its influence on position of the front, and influence of the loading on the parameters of the transition region and magnetic barrier. With respect to the influence of such loading mechanisms as photoionization and charge exchange on field strength in the magnetic barrier, in the frontal region photoionization and charge exchange counteract one another. Charge exchange, without changing the number of particles, eliminates hot solar wind protons and replaces them with cold planetary ions, which should result in a decrease in kinetic pressure and an increase in magnetic pressure. On the other hand, photoionization adds particles and accordingly increases the kinetic pressure of plasma and decreases the magnetic pressure. In the terminator region both loading mechanisms result in an increase in curvature of the magnetic lines of force and, therefore, an increase in magnetic field strength. In general, however, the influence of loading on magnetic field strength in the barrier near Venus is considerably weaker than on bow shock position and configuration. Figures 4; references 25: 3 Russian, 22 Western.

5303/8309
CSO: 1866/68

UDC 523.66

THERMAL AND PHOTOMETRIC MODEL OF COMETARY NUCLEUS

Moscow ASTRONOMICHESKIY VESTNIK in Russian Vol 21 No 1, Jan-Mar 87
(manuscript received 5 May 86, after revision 3 Nov 86) pp 47-60

[Article by M.Ya. Marov, A.V. Kolesnichenko and Yu.V. Skorov, Applied Mathematics Institute imeni M.V. Keldysh, USSR Academy of Sciences]

[Abstract] A model of the physical processes transpiring in a cometary nucleus and the circumnucleus region was devised. In the model it is assumed that an atmosphere consisting of a mixture of gas and fine dust particles, which are transported from the nucleus by the gas flow, is formed at small heliocentric distances during disintegration of the cometary nucleus as a result of heating by solar radiation and sublimation of its volatile components. A significant change in the distribution of radiation intensity in the circumnucleus region results from the presence of great numbers of micron and submicron dust particles in the coma. Due to the anisotropy of sublimation of volatiles from the nucleus surface (caused by its nonuniform heating) a non-zero resultant "jet" force arises which results in perturbations of orbital motion. In the first stage of the work the temperature distribution in the nucleus was found using a quite complete thermal model of a spherically symmetric nucleus. In the second stage a photometric model of the gas-dust cometary atmosphere in the circumnucleus region was computed by numerical solution of the radiation transfer equation in the optical wavelength range. A photometric model of the gas-dust atmosphere was computed. With stipulated coma dust content, particle shape, particle-size distribution and chemical composition, this model made it possible to obtain quantitative estimates of brightness of the cometary nucleus and gas-dust atmosphere as a function of heliocentric distance, radial distribution of gas density and temperature, and other factors. Figures 12; references 13: 7 Russian, 6 Western.

5303/8309
CSO: 1866/74

UDC 523.61;523.64

REFINEMENT OF COORDINATES OF HALLEY'S COMET WITH ALLOWANCE FOR DISPLACEMENT OF OPTICAL CENTER RELATIVE TO COMETARY CENTER OF MASS

Moscow ASTRONOMICHESKIY VESTNIK in Russian Vol 21 No 1, Jan-Mar 87 (manuscript received 16 Jan 86) pp 61-64

[Article by V.V. Savchenko, Applied Mathematics Institute imeni M.V. Keldysh, USSR Academy of Sciences]

[Abstract] In developing a theory of motion of Halley's comet, E.K. Akim, et al. (DOKL. AN SSSR, Vol 272, pp 1091-1096, 1983) studied the influence of displacement of its optical center relative to the center of mass on the accuracy in determining coordinates on the assumption that there is a systematic displacement of the brightness center which is difficult to separate from the considerable random component caused by instrumental and observer errors and other factors. Continuing this research, the author proposes a new variant of assignment of weights to observation errors with allowance for two independent components of observation errors: one caused by random errors and the other being the postulated error caused by displacement of the observed brightness center, the latter being similar to the phase correction which is used in processing position observations of planets. Comparison of the new computations with the results obtained by television observations from aboard the "Vega" spacecraft demonstrated the effectiveness of the proposed algorithm. A table gives comparative data for orbits 19 and 20 and the latter orbit with allowance for corrections for displacement of the optical center. These corrections made it possible to increase the accuracy in determining cometary coordinates by almost an order of magnitude. The error in determining coordinates is now not more than 100 km. The proposed method can also be used in precise determination of the coordinates of other comets. Figure 1; references 4: 2 Russian, 2 Western.

5303/8309
CSO: 1866/74

TASS REPORTS FIRST FLIGHT TEST OF 'ENERGIYA' BOOSTER

Moscow IZVESTIYA in Russian 18 May 87 p 1

[Text] TASS announcement. Developmental flight testing of a powerful new multipurpose launch-rocket named "Energiya" has begun in the Soviet Union. This rocket is intended for placing into near-Earth orbits both reusable orbiting spaceships and also large spacecraft for scientific and economic purposes.

The two-stage multipurpose launch-rocket has a launch weight of more than 2,000 tons, and it is capable of placing a payload of more than 100 tons into orbit.

The first such rocket was launched from the Baykonur Cosmodrome on 15 May 1987 at 2130 hours Moscow time.

After completion of the work of the engines of the first stage, this stage separated and landed in the designated area of the territory of the Soviet Union.

The launch-rocket's second stage continued to work in strict accordance with the flight assignment, delivering a satellite mockup with full size and weight to the prescribed point. After the separation of the mockup, the second stage splashed down in the designated area of the waters of the Pacific Ocean.

After the separation, the full-size full-weight mockup was supposed to have reached a near-Earth, circular orbit with the aid of its own engine. Due to irregular functioning of its onboard systems, however, the mockup did not attain the prescribed orbit, and it splashed down in the waters of the Pacific Ocean.

The launching and flight of the launch-rocket confirmed the correctness of design, engineering and technical solutions, as well as the high reliability of the design and of the engines of both stages and their control systems. The equipment and automated control instrumentation of the launch complex functioned normally. The objectives and tasks of the first launch were fulfilled in their entirety.

Taking part in the development and testing of the new-generation heavy multipurpose launch-rocket and of its unique launch complex were workers of numerous scientific research, design, industrial and construction organizations and also military specialists.

The successful beginning of developmental flight testing of the launch-rocket "Energiya" represents a major success of Soviet science and technology in the year of the 70th anniversary of the Great October Revolution, and it opens a new stage in the advancement of Soviet space rocketry, as well as broad prospects for the peaceful exploration of space.

FTD/SNAP
/8309
CSO: 1866/110

PRESIDENT OF ACADEMY OF SCIENCES MARCHUK INTERVIEWED ON 'ENERGIYA' LAUNCH VEHICLE

Moscow KRASNAYA ZVEZDA in Russian 22 May 87 p 4

[Abstract] The article records an interview with academician G.I. Marchuk, president of the USSR Academy of Sciences, in connection with the beginning of developmental flight testing of the new launch-rocket "Energiya."

Asked to describe the "Energiya," Marchuk said the following:

"'Energiya' is a two-stage launch-rocket. It is designed as a 'bundle,' with the payload that it carries attached to its side. Its first stage consists of four side booster units. The second stage is a central unit that is 60 meters long and 8 meters in diameter. The engines of the first stage burn an oxygen-kerosene fuel, and the engines of the second stage burn an oxygen-hydrogen fuel. The 'Energiya' rocket has a launch weight of more than 2,000 tons, and it can orbit a payload of more than 100 tons.

"As a multipurpose vehicle, it makes it possible to place into near-Earth orbits both reusable spaceships and other large spacecraft for scientific and economic purposes."

Marchuk went on to say that the "Energiya" represents a new stage in the development of space rocketry and in the program of space exploration for peaceful purposes, being the main link of a reusable space transport system that is being developed in the USSR. He said that further work is being done to develop large orbiting stations and large modules for them, and therefore the work on the reusable transport system envisages the possibility of its joint work with future manned orbiting complexes. Marchuk added that operation of the "Energiya" is expected to expand substantially activities in space, including the following potential uses: placing heavy communications satellites into geostationary orbit and sending unmanned interplanetary stations into far space and to the sun; assembling multipurpose orbiting complexes consisting of large blocks and structures; and deploying in orbit experimental solar power units having a large area of solar batteries for supplying needs of space industry.

At the same time, Marchuk said there are no plans to turn away from reliable existing launch-rockets, which will continue to be used for delivering payloads into space. The intention is to achieve an optimum combination of launch-rockets of various classes, of spaceships, of interorbital boosters and other space vehicles for an efficient transport system that meets the needs of the further development of the space program.

Asked what are the future plans of the Soviet space program, Marchuk replied that hopes are being placed in development of extensive international cooperation in the peaceful use of space as a constructive alternative to plans for the spread of the arms race into space. He observed, however, that the future direction of the Soviet space program will depend to a great extent on the actions of the United States.

FTD/SNAP
/8309
CSO: 1866/110

AVDUYEVSKIY COMMENTS ON 'ENERGIYA' TEST FLIGHT

Moscow IZVESTIYA in Russian 23 May 87 p 1

[Abstract] The article records commentary by academician V. Avduyevskiy on the first flight of the new space launch-rocket "Energiya." Following are excerpts of his comments:

"...The rocket consists of a central unit and four side units. The central unit has four engines, and the four side units have one engine each. The engines of the side units are the most powerful in the world. The rocket's total power is 170 million horsepower. In the central unit, the fuel used consists of liquid hydrogen and liquid oxygen....

"As you know, 'Energiya' is capable of carrying a payload weighing more than 100 tons into space. This is twice the weight of the scientific complex currently in orbit, which consists of the 'Mir' station, the 'Kvant' module, the manned ship 'Soyuz TM-2,' and the cargo ship 'Progress-30'...

"The operation of all of the rocket's systems is monitored and controlled by clever computers, which insure the execution of the flight program. I should make special mention of the total automation of prelaunch servicing, fueling, and monitoring of all onboard systems during the launch and in flight. The level of computer programming for the new launch-rocket is higher by two orders of magnitude in comparison with all previously developed rockets. The computers monitor and control more than 2,000 parameters. This has become possible due to the fact that the launch pad is equipped with a large computer complex which assumes control of a multitude of aggregates and mechanisms involved in the flight preparations. This complex interacts with onboard computers which continuously monitor the condition of all of the rocket's systems on the launch pad..."

Avduyevskiy also responded to two questions asked by the newspaper's editors. He was asked why, if the rocket system is as highly reliable as he claims, the mission of the first flight was not accomplished in its entirety. Avduyevskiy replied it was essential to understand that the rocket itself performed perfectly as intended. He said there were no hitches throughout the entire active sector of the rocket's flight: the first and second stages burned precisely for the times designated in the flight program, and the second stage delivered the payload in the form of a satellite mockup to the designated point

in near-Earth space. The separation of the payload from the rocket took place as intended. The full-size, full-weight mockup then was supposed to have climbed to a circular orbit under the power of its own engine, but its orientation system failed during the burn of its engine, and it failed to reach the intended orbit. Avduyevskiy said the failure with the payload, however, had nothing to do with the delivery vehicle, which operated flawlessly and transmitted a vast amount of information on the performance of its structure and systems in flight.

Avduyevskiy was asked whether this meant that a launching of a Soviet reusable spaceship could be expected in the near future. He replied that a careful reading of the report on the first flight of "Energiya" reveals that there are no 'specific promises' on this count. He stressed that the report says only that the new rocket is capable of orbiting reusable spaceships and also large scientific modules, and added that which system receives priority depends on the direction that will have to be followed in the space program.

FTD/SNAP
/8309
CSO: 1866/110

DUNAYEV COMMENTS ON 'ENERGIYA,' NEW SPACE TRANSPORT SYSTEM

Moscow PRAVDA in Russian 11 Jun 87 p 6

[Article by A. Dunayev, head of the USSR Main Administration for Development and Use of Space Technology for the Economy and Scientific Research (Glavkosmos)]

[Abstract] The author discusses what the new launch-rocket "Energiya" means for the further development of the space program. He begins by tracing the history of development of Soviet launch-rockets, from the "Sputnik" that launched the first artificial satellite in 1957 through the large "Proton" rocket. Features that improved capabilities of rockets of each succeeding generation are noted. Characterizing the growing scope of activity in space and the prospects that are foreseen in the coming decades, the author explains the rationale of the "Energiya" rocket's development as follows:

"The anticipated growth of payload deliveries from Earth into space poses at the present time the question of creating a special space transport system in our country. It should consist of new, more powerful launch-rockets, and of reusable transport spacecraft and interorbital transport spacecraft. One of the main requirements of such a system is economy of transport operations. This economy may be achieved through partially or fully reusable launch-rockets possessing a payload capacity that is higher than that of existing rockets which are used only one time. Reusable spaceships also are more expedient for transport operations. To make intensive interorbital shuttle flights economical, it is necessary also to develop and operate interorbital transport spacecraft, or so-called 'space tugs.'

"The technological prerequisites for the origin of a space rocket launching system with reusable elements have developed throughout the whole evolution of space-rocket technology in our country. Numerous captive firing tests have confirmed the possibility of repeated use of liquid-propellant main rocket engines with great thrust, operating on both high-boiling and cryogenic fuel components. Considerable successes have been achieved in development of effective structural and heat-shielding materials. A large volume of theoretical and test data has been amassed also with respect to the aero-dynamics and aerothermal characteristics of flying vehicles returning from orbit and flying in the atmosphere in a wide range of speeds.

"However, it must be stated most definitely that the development of reliable transport means is extremely complex, requiring a large amount of research and of ground and flight testing of scale models and full-scale products. This is why each stage of development of the new transport means must be carried out at an exceptionally high scientific-technical level."

The author goes on to describe the "Energiya" rocket. He mentions that the length of the vehicle is 60 meters, and its maximum cross-sectional dimension is about 20 meters, while the diameter of its second stage is 8 meters. The first stage is said to consist of four units which possess the world's most powerful liquid-propellant engines, burning an oxygen-hydrocarbon fuel. Each of these engines develops a thrust of 800 tons. The second stage has oxygen-hydrogen engines with a thrust of 200 tons each. The main engines are said to possess an increased service life and are equipped with a diagnostic system that increases flight safety. The author describes the launch-rocket as a multipurpose delivery vehicle, pointing out that the carrying of the payload on the rocket's side makes it possible for the rocket to deliver both unmanned spacecraft of different sizes, and also manned spaceships with extended aerodynamic surfaces.

A photograph is given showing the "Energiya" on its launch pad.

FTD/SNAP
/8309
CSO: 1866/110

DISCUSSION OF 'ENERGIYA' LAUNCH CONTROL SYSTEMS

Moscow IZVESTIYA in Russian 12 Jun 87 p 3

[Article by V. Karashtin, Doctor of Technical Sciences, Professor]

[Abstract] The author describes the launch complex for the new multipurpose heavy launch-rocket "Energiya" focusing on its control system. He notes that every element of the complex was developed taking account of specific features of the rocket.

Beneath the complex is a facility for drawing off gases from the rocket's engines. It reportedly is large and deep enough to hold an entire city block of 12-story buildings. Cryogenic fuel components are stored in sphere-shaped reservoirs on the ground. There is a mobile servicing tower which rolls away to a safe distance before the launch, as with the "Proton" rocket complexes. This tower's service levels have fold-out platforms that provide access to practically any part of the rocket's surface. The author says that a distinguishing feature of the mast of the complex that holds the umbilical connections is that one of its platforms separates only after the rocket begins lift-off; a special tube draws off excess hydrogen to preclude mixing with atmospheric air.

The author also calls attention to an innovation in the rocket's structure: to reduce its weight, the effect of cryogenic hardening of metal has been employed. At very low temperatures, the strength of tanks and of compressed-gas cylinders and of units that connect tanks is increased significantly, making it possible to use thinner metal walls in them.

The author goes on to discuss at length the computerized control system of the complex. The control automation is said to consist of three links. First is a system for control of launch preparations, which directs the other links and is the only one that can issue commands to the rocket itself. The second link supplies the initial essential data about the condition of the rocket. The automation equipment of the third link controls the flow of fuel components and gases from reservoirs to the rocket, and ensures safety in the ground facilities of the complex.

The author reports that all of the automated control systems use Soviet computers, both series-produced ones and ones that were developed specially for the complex. He makes the following comments about the development of the computer system:

"The complexity [of the development] was that it was necessary to design the system parallel with the construction of the launch complex and with the development and building of the rocket. When they started work, the developers of the control system did not yet know the final procedure for preparing the rocket and the whole list of elements that had to be controlled.

"Usually it takes three years to develop the computer system, to manufacture the instrumentation, and to conduct tests. And at least another two years must be added to this time, when you consider that programs on which the operation of all the machines depends still must be developed. In view of the deadlines that were imposed on the developers of the systems for controlling the preparation and launch of 'Energiya,' the decision was made to develop apparatus into which any program could be entered; in other words, to make it adaptable to solving any problem. Overall, this apparatus is much more complex than systems for controlling nuclear power stations..."

The author explains that a special system for interfacing a large number of computers was developed, and original solutions for producing software were employed. The developers employed the method of describing operational procedures of the ground complex in the form of a special model, a so-called 'law of control.' They departed from traditional programming and adopted the so-called declarative representation of the technological process. Information is presented in a way that it can be input to a computer immediately, dispensing with all functions of programmers.

The author goes on to comment on the different levels of the computer system, mentioning the numbers of complexes, machines and processors involved.

FTD/SNAP
/8309
CSO: 1866/110

GLAVKOSMOS OFFICIAL COMMENTS ON 'ENERGIYA' BOOSTER

Minsk SOVETSKAYA BELORUSSIYA in Russian 7 Jun 87 p 3

[Excerpt] Novosti Press Agency science commentator Mikhail Chernyshov talked with Stephan Bogodyazh, head of a department of the USSR Main Administration for Development and Use of Space Technology for the Economy and Scientific Research, about the testing of the powerful rocket "Energiya" that has begun in our country, and also about prospects for its uses.

"First of all, would you say a few things about the new rocket and its capabilities? What have tests shown?"

"The two-stage rocket 'Energiya,' which has an initial mass of more than 2,000 tons, can carry spacecraft weighing more than 100 tons into orbit. The rocket is a versatile one; i.e., it can deliver into space massive modules for future orbiting stations, satellites, or reusable orbiting spaceships, for example."

"Specialists are saying that with the 'Energiya' rocket, Soviet cosmonautics appear to be entering a qualitatively new period."

"Up until recently, existing rockets such as the 'Kosmos,' 'Soyuz' and 'Proton' covered the whole range of payloads that could be carried into space. The 'Proton,' incidentally, can deliver a payload of more than 20 tons into low orbit and a payload of more than 3 tons into geostationary orbit. But we must look to the future, too. Undertakings such as construction in space, and production of semiconductors and medicines in space are already past the talking stage. Who knows, unmanned plants for producing such products may appear in space no later than the turn of the next century. In any case, preparations for this must be made now, and the 'Energiya,' whose capabilities exceed those of the 'Proton' by five times, gives us a 'reserve' for the long run. On the other hand, the new launch rocket is needed also in the near future, considering its capability to be used for delivering large new orbiting stations and large modules for them into orbit."

FTD/SNAP
/8309
CSO: 1866/110

EMERGENCY CREW RESCUE DURING 'SOYUZ T-8' LAUNCH FAILURE RECALLED

Moscow KRASNAYA ZVEZDA in Russian 30 May 87 p 4

[Abstract] The article describes how cosmonauts Vladimir Titov and Gennadiy Strekalov were saved by an emergency capsule-ejection system when there was an accident with the rocket on the launch pad on 26 September 1983. The article consists of descriptions of the incident by Titov and by KRASNAYA ZVEZDA correspondent M. Rebrov.

It is noted that this was the only time in the history of the space program that the emergency rescue system had to be activated. A photograph accompanies the article, showing the top of the rocket where the spaceship sits. Attention is called to a 'skirt' ringing the spaceship. It is explained that this skirt contains solid-fuel engines which, in the event of an accident on the pad or during the rocket's ascent, fire automatically and propel the spaceship consisting of the orbital module and the reentry module upward and away from the rocket. The modules then separate, and the reentry module with the crew descends by parachute.

It is recalled that Titov and Strekalov, along with Aleksandr Serebrov, had flown a mission just five months earlier, in the "Soyuz T-8" spaceship. The code name of the Titov-Strekalov crew for the planned mission in September 1983 was "Okeany." The scheduled launch time was 2337 hours. The temperature that day had been 27 degrees Celsius, but by launch time it had fallen to 10 degrees. There were wind gusts of up to 12 meters per second.

The narrative of Titov and correspondent Rebrov is picked up two hours before launch, when the crew entered the spaceship. Rebrov describes the scene and activities at the launch site, and Titov's narrative consists mainly of his thoughts and sensations. Preparations proceeded routinely. Rebrov recalls that the first indication to him that something was amiss was when the umbilical cord did not detach when it should have. At 25 seconds remaining in the countdown, he noticed an unusual reddish-yellow flame. Black smoke began to rise around the rocket. There was no sound of engines. Titov recalls feeling a rocking motion, which he thought was from a wind gust. Then there were two unusual waves of vibration, followed by a strong jolt. Rebrov recalls that smoke of yellow, red, black and orange colors rose almost to the top of the rocket, and then something shot upwards into the dark sky, with sparks shooting from it.

Flight controllers announced that the emergency system had fired. Observers then saw as a searchlight revealed an open parachute in the dark; it descended with the capsule beneath it, and dust was kicked up by the capsule's soft-landing engines. Titov recalls that he and Strekalov remained passive throughout the incident. The emergency system had operated flawlessly.

FTD/SNAP
/8309
CSO: 1866/110

SHATALOV DISCUSSES EMERGENCY CREW RESCUE SYSTEM

Moscow GUDOK in Russian 19 May 87 p 4

[Article by Vladimir Shatalov, pilot-cosmonaut of the USSR, head of the Cosmonaut Training Center imeni Gagarin]

[Abstract] The article consists of random reflections by the author on his career as a cosmonaut, and on the nature of the profession. In one part he talks about the factor of working constantly in the face of risks, including very serious ones. As an example, he recalls an accident that occurred in the launch-rocket when a crew consisting of Vladimir Titov and Gennadiy Strekalov was about to begin a flight. The author explains that the space launch system has emergency means of rescuing the crew in the event of an accident on the launch pad or anytime up until the spaceship practically goes into orbit. Small powder-fuel engines propel the spaceship away from the rocket. At an altitude of 600-700 meters the spaceship divides in two, and the crew descends by parachute. The author notes that in addition to instrument monitoring, there are two operators who monitor the safety situation during a launch and make decisions independently of one another. In the incident with the Titov-Strekalov crew, these operators both made the decision to activate the emergency system. The cosmonauts landed safely four kilometers from the launch pad.

FTD/SNAP
/8309
CSO: 1866/110

BIOLOGICAL AND SEMICONDUCTOR MATERIALS RETURNED FROM 'COSMOS-1841' SATELLITE

Moscow IZVESTIYA in Russian 29 May 87 p 1

[Text] On 27 May ampoules containing unique semiconductor alloys and biologically active substances obtained in zero gravity were turned over in the USSR Main Administration for Development and Use of Space Technology for the Economy and Scientific Research (Glavkosmos) to representatives of scientific organizations who took part in the preparation of experiments on the spacecraft "Cosmos-1841." This unmanned laboratory was launched on 24 April and returned to Earth on 8 May.

A. Dunayev, head of USSR Glavkosmos, noted that the work accomplished with this spacecraft has furthered the program of space materials science and biotechnology which began with "Cosmos-1645" and "Cosmos-1744."

In particular, two special furnaces intended for obtaining semiconductor materials for electronic and infrared technology operated on board "Cosmos-1841" during its flight. Experiments for purifying biologically active substances, timozin and interferon, were performed in an electrophoresis unit called "Kashtan." These substances are used in the treatment of immune, viral and other disorders.

FTD/SNAP
/8309
CSO: 1866/110

RESEARCH INSTITUTES RECEIVE MATERIALS PRODUCED ABOARD 'COSMOS-1841'

Moscow TRUD in Russian 28 May 87 p 4

[Article by V. Golovachev]

[Excerpt] Unique new materials obtained in outer space will be used by scientists to develop medicines to fight many dread diseases.

The prospect of laboratories in space has enticed specialists for a long time. In such laboratories, where gravity is zero, impurities can be removed literally molecule by molecule and superpure substances thus obtained. The first biotechnology experiments of this kind began as far back as the late 1960s and early 1970s. This work has continued on both Soviet manned stations and unmanned satellites.

The most recent technological satellite, "Cosmos-1841," was launched from the Soviet Union on 24 April. It made a soft landing in the designated area on 8 May at 1120 hours. The preparations that it brought back were at an institute by about 1900 hours. These preparations were obtained in space, in a unit called "Kashtan," in which experiments for purifying a thymus hormone were conducted automatically. Alpha-1-thymozin, which is used to treat disorders of the human immune system, was obtained.

Another preparation that was obtained is a type of interferon which is used to treat viral and tumor diseases. For now, these materials are intended not for medical treatment, but rather for research whose importance is hard to overestimate.

Yesterday, the unique materials were turned over in the USSR Main Administration for Development and Use of Space Technology for the Economy and Scientific Research to officials of the Scientific Research Institute of Biomedical Technology and the All-Union Scientific Research Institute of Technology of Blood Substitutes and Hormonal Preparations, which will do research with them.

Experiments for making semiconductors were also performed on board "Cosmos-1841." These specimens were turned over to metallurgical research institutes yesterday.

FTD/SNAP
/8309
CSO: 1866/110

SATELLITES USED IN EXPERIMENT ON WATER QUALITY OF INLAND RESERVOIRS

Kiev PRAVDA UKRAINY in Russian 7 Jun 87 p 1

[Text] Improvement of remote methods for studying lakes and reservoirs and the quality of their waters is the objective of an international aerospace experiment, "Vnutrenniye Vodoyemy-87" (inland waters-87), which is being conducted on the Rybinsk Reservoir.

In the "Intercosmos" council of the USSR Academy of Sciences, it is being reported that specialists of the USSR, Bulgaria, Poland and Czechoslovakia are taking part in this experiment, which will last until 20 June. The institutes of limnology, biology of inland waters, water problems, and geography of the USSR Academy of Sciences are its organizers. Observations are being made also by specialists of a number of educational and industrial organizations who are studying the problem of protecting inland waters.

The condition of the reservoir's water and of the drainage basin of its western tributary, the Sit River, will be studied simultaneously from surface vessels, laboratory airplanes, and satellites of the series "Meteor-Priroda" and "Cosmos."

FTD/SNAP
/8309
CSO: 1866/110

EFFICIENCY IN USE OF AEROSPACE PHOTOGRAPHS IN REGIONAL PLANNING AND URBAN CONSTRUCTION

Novosibirsk GEOGRAFIYA I PRIRODNYYE RESURSY in Russian No 4, Oct-Dec 86 (manuscript received 4 May 85) pp 108-112

[Article by M.D. Kostyuk and S.D. Mityagin, Leningrad Civil Engineering Institute]

[Abstract] Since the expenditures of a planning agency can be reduced considerably by a reduction in time spent in collecting, preparing and processing initial data, the use of aerospace photographs of the earth's surface as materials representing the natural and anthropogenic landscape represents an important means for achieving this goal. In the planning of urban construction it is desirable that interpretations of such photographs be used as information which lessens the amount of work for field correction of map bases. Whereas expenditures on fieldwork are reduced, there are costs involved in acquiring or leasing and analysis of the aerospace survey. At present, planning agencies do not share in the costs of topogeodetic surveys and map production, which are paid for from the national budget, but only for printing. Similarly, such agencies should not pick up costs of aerospace photography. It is proposed that a data bank for space surveys of the earth (BDKSZ--bank dannykh kosmicheskikh syemok Zemli) be organized; such a centralized bank would consist of national, regional and group centers. Users would pay for the materials ordered, without reimbursement for the costs in collecting and processing these materials. It is conceivable that at some time in the future this policy might be changed. This would provide planning (and construction) agencies with a wealth of valuable information whose presence in the bank can also be accessed by other branches of the national economy and science. Territorial (specialized) banks might also be established; a block diagram is given showing the possible organization of such a regional bank. A number of formulas are derived for evaluating the economic effect from use of aerospace materials in urban planning and construction. Figures 2; references: 3 Russian.

5303/8309
CSO: 1866/53

UDC 551.466.8:629.78

MERIDIONAL SHIFTS OF THE INTERTROPIC CONVERGENCE ZONE IN THE ATLANTIC OCEAN

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, Jan-Feb 87 (manuscript received 5 Nov 85) pp 14-19

[Article by G.S. Dvoryan inov and A.V. Prusov, Marine Hydrophysics Institute, Ukrainian Academy of Sciences, Sevastopol]

[Abstract] Satellite information on changes in the position of the intertropic convergence zone is statistically processed to yield estimates of the spectra of meridional shifts of the zone and determine their basic periods over intervals of 2 to 20 days. It is shown that the frequencies of local maxima in the spectra correspond to the frequencies of the basic synoptic waves in the tropical Atlantic. The amplitudes of oscillations of the zone increase and frequencies decrease from West to East. The spectra of pressure fields and meridional shifts of the convergence zone are correlated, as is the variation in ocean surface temperature and wandering of the convergence zone.
Figures 4; references 11: 6 Russian, 5 Western.

6508/8309
CSO: 1866/56

UDC 551.461:629.78

MAJOR MORPHOLOGIC FEATURES OF THE ATLANTIC OCEAN SURFACE

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, Jan-Feb 87 (manuscript received 15 Aug 85) pp 20-25

[Article by R.Kh. Greku, Marine Hydrophysics Institute, Ukrainian Academy of Sciences, Sevastopol]

[Abstract] Satellite altimetry was used to produce new information on the topography of the surface of the Atlantic Ocean. Surface topography anomalies result both from heterogeneities in the geological structure of the Earth and from hydrodynamic phenomena in the ocean. This article discusses large-scale features of the Atlantic Ocean surface and compares them with known geomorphologic features of the bottom relief. Initial data used included a sea surface map based on "Seasat" data. The maximum variation in surface level is observed in the North, where the difference is almost 120 meters. At 30°N the variation reaches 80 meters, at the equator up to 40 meters, in the South Atlantic at 20°S it is about 30 meters, at 40°S it is 40 meters. The maximum mean sea surface slope of -9.6" is observed in the Labrador Sea, with an area of slopes from -6.0" to -7.5" extending to the South somewhat to the West of the axis of the Mid-Atlantic Ridge at the latitude of the tropics. The area extends in the West to the Bermuda Rise and is adjacent to the Mid-Atlantic Ridge in the East, where the steepness reaches -8.1." The morphology of the isopotential surface of the geoid in the North Atlantic results primarily from the gravitational field of large density anomalies located at great depth. In the South Atlantic the orientation of the surface slope isolines is determined more by the influence of ocean bottom relief. Figures 3; references 11: 6 Russian, 5 Western

6508/8309
CSO: 1866/56

UDC 551.465:629.78

STUDY OF VARIATIONS IN RADIO THERMAL RADIATION OF SEA AT GRAZING SOUNDING ANGLES IN CONDITIONS WITH A DEVELOPING STORM

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, Jan-Feb 87 (manuscript received 11 Oct 85; after revision 4 Mar 86) pp 35-37

[Article by V.B. Venslavskiy, N.M. Maslennikov, V.G. Mirovskiy and V.S. Etkin, Institute of Space Studies, USSR Academy of Sciences, Moscow; Moscow State Pedagogic Institute imeni V.I. Lenin]

[Abstract] Results are presented from an experimental study of the radiation characteristics of the surface of the sea as a function of wind speed and long-wave height as a storm develops. Measurements were performed in 1984 in the Pacific from a research vessel by means of 1.5 and 2-cm wave band radiometers. The true wind speed at 20 m above the surface of the sea was measured, wave height and sea surface condition were estimated. The radio brightness temperature of the sea surface was measured in continuous mode for 10 days to determine variations in the radiation characteristics of the sea surface as a function of wind speed and wave height. The maximum differences in values of radio brightness temperature was determined as the ship circled at 4 knots twice per day under conditions such that the angle between the wind direction and the direction of propagation of the swell did not exceed 30°. Values of this parameter, called ΔT_c, vary linearly as a function of wind speed for developed wave action. ΔT_c is not over 5 K at wind speed 4-12 m/s and wave height 1-4 m the wind speed can be determined with an accuracy of about 2 m/s and wave height with an accuracy of about 0.5 m by such measurements at grazing angles in vertical polarization, regardless of the angle between the sighting direction and the direction of the waves. Figures 2; references 8: 7 Russian, 1 Western

6508/8309
CSO: 1866/56

UDC 551.4:528.77+629.8

STUDY OF FORMATION OF CONTEMPORARY LANDSCAPE OF LOWER MESOPOTAMIA FROM SPACE PHOTOGRAPHS

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, Jan-Feb 87 (manuscript received 12 May 86) pp 51-58

[Article by Ye.V. Glushko and I.N. Maslennikova, Department of Geography, Moscow State University imeni M.V. Lomonosov]

[Abstract] The authors' group studied space photographs of the territory of Iraq made from the "Salyut-6" station. The 1:2,400,000 monochrome images had a spatial resolution of 70 m. A sample space photograph and diagrams illustrating the interpretation of modern landscapes and processes of anthropogenic desert formation are presented. Processes of secondary salinization are virtually universal in irrigated areas, aggravated by excess flooding with highly mineralized water, with drainage water dumped back into the Tigris and Euphrates rivers and then reused for irrigation. Anthropogenic desert formation has reached catastrophic scale in formerly irrigated areas. Land irrigated and abandoned 3,000 years ago has now been fully converted to desert, and is being gradually joined by land irrigated since then. The abundant collection of water for irrigation and dumping of drainage water into practically undrained depressions in the Central Mesopotamian lowland has desertified huge territories North of the Tigris-Euphrates confluence since 1954. Figures 3; references 16: 14 Russian, 2 Western

6508/8309
CSO: 1866/56

UDC 634.4:629.78

USE OF SPACE PHOTOGRAPHS TO STUDY SOIL COVER AS A LANDSCAPE COMPONENT ON EXAMPLE OF THE ARMENIAN MOUNTAINS

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, Jan-Feb 87 (manuscript received 3 Dec 85; after revision 8 Apr 86) pp 59-66

[Article by A.B. Bagdasaryan, T.V. Afanasyeva and T.A. Trifonova, Moscow State University imeni M.V. Lomonosov; Institute of Geological Sciences, Armenian Academy of Sciences, Yerevan]

[Abstract] Studies were performed using monochrome space photographs taken in the near infrared at 0.8-1.1 μm wavelength and synthesized photographs obtained in false color in 3 spectral zones (green (0.5-0.6 μm), orange (0.6-0.7 μm), and near infrared (0.8-1.1 μm)) from the Landsat satellite in November of 1982. High altitude natural belts were distinguished by analysis of medium scale maps, a series of thematic maps and the space photographs. The analysis was used to distinguish typical characteristics for interpretation for each belt, allowing more accurate and reliable determination of landscape components. The belts are listed in a table showing climate type, relief, geological structure, vegetation, soil and interpretation characteristics used on the monochrome photographs and synthesized false color images. Figure 1; references 8: Russian.

6508/8309
CSO: 1866/56

UDC 551.4:629.78

ORIGIN OF LAKE ISKANDERKUL (BASED ON RESULTS OF INTERPRETATION OF SPACE PHOTOGRAPHS AND SURFACE OBSERVATIONS)

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, Jan-Feb 87 (manuscript received 12 Nov 85; after revision 30 Jan 86) pp 67-71

[Article by A.I. Lavrusevich, State Scientific Research and Production Center "Priroda"]

[Abstract] The author utilized surface measurements plus medium scale monochrome space photographs obtained from a "Cosmos" series spacecraft in the Summer of 1979, plus enlarged photographic images from the "Salyut-4" and "Salyut-6" stations taken in 1975 and 1978 to interpret the geological structure of the vicinity of Lake Iskanderkul. The results of the study support the opinion that the source of the fragmentary material making up the dam of the lake was the right bank of the Iskanderdarya River, though it does not seem to have been a moraine. The space photographs clearly show that the source of the material was a sector of the right slope of the river drained by several streams flowing from the Khazormech Mountains. Glacial origin of the Iskanderkul Dam is also revealed as improbable on the basis of the space photographs. However, glaciers played an important role in the formation of the relief of the vicinity of the lake. Figures 1; references 7: Russian.

6508/8309
CSO: 1866/56

UDC 631.4:629.78

METHOD OF REMOTE STUDY OF STATUS OF WINTER CROPS AFTER WINTERING

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, Jan-Feb 87 (manuscript received 21 Apr 86) pp 72-76

[Article by K.Ya. Kondratyev, S.M. Somova, V.V. Tuyev and P.P. Fedchenko, Institute of Lake Studies, USSR Academy of Sciences, Leningrad; All-Union Scientific Research Institute of Agricultural Meterology, Obninsk]

[Abstract] This article continues previous studies on the development of a remote method of determining the area of killed and damaged winter crops during the early spring. Laboratory, surface and aircraft experiments were used to study the spectral reflective and color characteristics of dead and healthy plants. A series of values of spectral brightness coefficients was determined characterizing the reflective properties of winter crops. The coefficients for dead plants were 5 to 10 times greater than those of healthy plants. The method developed can be used for rapid and accurate determination of the condition of winter crops after wintering. Figures 2; references 5: Russian.

6508/8309
CSO: 1866/56

UDC 528.727

REFINEMENT OF BOUNDARIES OF AGRICULTURAL FIELDS ON AEROSPACE PHOTOGRAPHS

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, Jan-Feb 87 (manuscript received 8 Apr 86) pp 77-84

[Article by A.S. Barykin, V.V. Kozoderov and V.P. Popov, Department of Computer Mathematics, USSR Academy of Sciences, Moscow; All-Union Scientific Research Center "Automated Information-Control System-Agroresources," Moscow]

[Abstract] Mathematical filtration was used to refine the boundaries of agricultural fields on air and space photographs. The method is based on construction of an operator S, used to process the image to improve the accuracy of location of boundaries between image areas with different characteristics. The use of the operator S can increase the sharpness of defocused brightness differences between homogeneous areas with straight boundaries, which is usually the case for agricultural fields. Each iteration of application of operator S improves the sharpness, but the degree of improvement with each iteration dimishes. Figures 4; references 9: 6 Russian, 3 Western.

6508/8309
CSO: 1866/56

UDC 528.8.044.1+528.831.1

RADAR OBSERVATIONS OF GROUND COVER IN 3-CM WAVEBAND

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, Jan-Feb 87 (manuscript received 17 Jan 86) pp 85-92

[Article by A.S. Gavrilenko, A.I. Kalmykov and A.P. Pichugin, Institute of Radio Physics and Electronics, Ukrainian Academy of Sciences, Kharkov]

[Abstract] Special experiments were performed using a side-looking radar carried by an Il-18 aircraft in order to study the reflective characteristics of agricultural crops and forests. This article discusses possible mechanisms of scattering of radar waves by these types of ground cover on the basis of the experimental results. Formation of the reflections returned under the experimental conditions is a complex process requiring the consideration of many factors to interpret the radar images. Radar images of an area made in spring and fall are presented with a map of the same area showing types of ground cover actually present. The studies show that the scattering properties of different ground cover structures varied widely as a function of season of year, status of plant cover and soil and observation condition. Coniferous and deciduous forests can be recognized from the tone and texture of the radar images. Early spring is best for mapping of forest boundaries, while the period when the trees are leafed out is best for identification of types of trees. Additional information on plowing is needed to distinguish between plowed fields and early sprouts of crops. Figures 5; references 12: Russian.

6508/8309
CSO: 1866/56

UDC 631.4:629.78

COMPARISON OF SPECTRAL BRIGHTNESS COEFFICIENTS OF AGRICULTURAL CROPS AS CALCULATED BY GOUDRIAAN MODEL AND MEASURED VALUES

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, Jan-Feb 87 (manuscript received 10 Apr 86) pp 93-101

[Article by N.N. Vygodskaya, I.I. Gorshkova and A.S. Ukhanov, Department of Geography, Moscow State University imeni M.V. Lomonosov]

[Abstract] In order to determine the correctness of previously calculated values of spectral brightness coefficient as a function of model parameters characterizing the status of vegetation and soil in the Goudriaan theoretical model of reflection of radiation by vegetation and soil, the authors performed field experiments involving direct measurements of spectral brightness coefficient and determination of the values of all input parameters of the Goudriaan model. Good qualitative agreement between calculated and experimental values was obtained. Where the vegetation is sparse, correct knowledge of the reflective properties of the soil is required. In crops with irregular spatial structure and large leaves, the agreement of the calculated and measured results depends largely on the spatial resolution of the radar apparatus used. Satisfactory agreement is achieved by averaging in this case. Further improvements in the model can be achieved by utilizing the true vertical profile of relative surface and orientation of photographic elements, as well as various spatial placements of the elements. Figures 2; references 10: 8 Russian, 2 Western.

6508/8309
CSO: 1866/56

UDC 502.3:629.78

STEREOSCOPIC VISUALIZATION OF AIR AND SPACE PHOTOGRAPHS IN THEMATIC MAPPING

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, Jan-Feb 87 (manuscript received 26 Aug 85) pp 102-110

[Article by R.Yu. Vitkus, V.Ye. Gendler, V.A. Ilin and L.P. Yaroslavskiy, Institute of Information Transmission Problems, USSR Academy of Sciences, Moscow; "Aerogeologiya" Geological Production Association, Moscow]

[Abstract] Stereoscopic visualization of space photographs involves the creation of synthetic stereoscopic pairs consisting of a brightness image and an image used to determine artificial relief. The brightness component may be the initial space photograph. The essence of the method is to construct from two images, i.e., the brightness image and the standard relief map, a synthetic stereoscopic pair. The relief map used is prepared from the initial or brightness image by processing according to equations presented in this article. Examples of utilization of the method for geological interpretation illustrate the possibility of stereoscopic visualization to increase the information content of space photographs for visual interpretation, primarily using brightness characteristics as the features to generate artificial relief. Other characteristics, including geometric, statistical or texture characteristics could also be used to generate the false relief. Figures 6; references 4: Russian.

6508/8309
CSO: 1866/56

UDC 528.7:551.5

CLOUD COVER AND PRECIPITATION MODES IN REPUBLIC OF GUINEA BASED ON SURFACE AND SATELLITE OBSERVATIONS

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 6, Nov-Dec 86 (manuscipt received 3 Feb 86) pp 11-17

[Article by N.A. Timofeyev, A.N. Bolshakov, M.V. Ivanchik and A.I. Sevostyanov, Marine Hydrophysics Institute, Ukrainian Academy of Sciences, Sevastopol]

[Abstract] Since May 1983 an atlas of maps of means monthly cloud cover has been compiled at the CERESCOR Scientific Center, based on NOAA satellite observations in the 0.725-1.1 μm wavelength band. Surface observation data on cloud cover during the time of passage of the satellite were used to analyze the satellite observations. The space-time regularities of variability of cloud cover in the Republic of Guinea were found to be almost completely determined by two factors: The mean position and dynamics of the tropical convergence zone and local topography. There are at least two nocturnal maxima in the diurnal course of precipitation intensity, shifting in time over the duration of the wet season. Figures 6; references 6: Russian.

6508/8309
CSO: 1866/48

UDC 528.88:551.23:553.98 (575.13)

EXPRESS ANALYSIS OF A LINEAMENT NETWORK ON EXAMPLE OF FERGANA DEPRESSION AND SURROUNDING MOUNTAINS

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 6, Nov-Dec 86 (manuscript received 16 Sep 85; after revision 5 Mar 86) pp 24-31

[Article by A.D. Baklanov, D.A. Tashkhodzhayev and V.M. Tanyukhin, "Priroda" State Scientific Research and Production Center]

[Abstract] The purpose of this work was to improve the method of analysis of lineament network diagrams obtained in the process of geological and structural interpretation of space photographs. Materials used included television photographs obtained from "Meteor" series satellites tracing high-order lineaments identified with regional fractures. The photographs were taken in two spectral bands: 0.5-0.6 and 0.7-1.1 um. Express analysis was used to construct 4 diagrams showing lineaments of various types. The analysis can be used to theoretically determine the direction of shear displacements on fault discontinuities. Express analysis of a lineament network is simple and quick and allows important conclusions to be drawn. Figures 2; references 8: Russian.

6508/8309
CSO: 1866/48

UDC 551.24:550.814 (-925.23)

GEOMAGNETIC INTERSECTION OF TECTONIC STRUCTURES SEEN IN SPACE PHOTOGRAPHS

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 6, Nov-Dec 86 (manuscript received 1 Nov 85) pp 32-37

[Article by M.I. Burleshin, "Gidrospetsgeologiya" Production Geological Association, Moscow]

[Abstract] Interpretation of space photographs yields information on positive tectonic structures in platform territories. Analysis of previous works indicates that positive tectonic structures of widely varied configurations are found by different authors in the same territory. This article attempts to analyze the reasons for this variety of interpretations and characterize the major types of intersections of tectonic structures. Recommendations are given for increasing the effectiveness of utilization of space photographs in geological structure studies: one should not limit oneself to location of the contour of a positive tectonic structure; reflection of several contours of intersecting positive structures allows more precise determination of the sequence and significance of tectonic deformations in forming the geological structure; combined systems are particularly significant for hydrogeological construction, since the motion of underground water within a tectonic structure primarily follows zones of increased jointing, seen on photographs as structural lines and contours of positive tectonic structures. Figures 2; references 5: Russian.

6508/8309
CSO: 1866/48

UDC 528.77:550.814 (-923)

GEOLOGICAL STRUCTURE OF LAMBERT GLACIER RIFT ZONE (ANTARCTICA) BASED ON SPACE PHOTOGRAPH INTERPRETATION

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 6, Nov-Dec 86 (manuscript received 3 Jul 85) pp 38-47

[Article by V.M. Budko and V.S. Shalayev, Laboratory of Aerial Methods, "Aerogeologiya" Geological Production Association, Leningrad]

[Abstract] Geological interpretation of aerial photographs was performed for the region of the Prince Charles Mountains and Lambert Glacier, the principal area of geological research of the Soviet Antarctic Expedition. Space photographs were also interpreted for the entire territory. This article studies results of interpretation of "Cosmos" satellite 1:1,200,000-scale photographs of an area covering 68-75°S, 60-75°E, the central portion of which is occupied by a large (400 x 100 km) depression containing Lambert Glacier. A detailed diagram of the disjunctive tectonics of the region was produced and a number of circular structures revealed, probably magmatogenic and related to formation of the rift. In the southern portion of the territory is a tectonic zone apparently related to the period of Ross activation, controlling the process of formation of granite-gneiss domes and determining the metallogenic features of the region. The arch-volcanic nature of the western branches of the rift zone, possible presence of volcanogenic complexes in the Cenozoic formations and signs of relative vertical displacement of major tectonic blocks are confirmed. Figures 4; references 22: 21 Russian, 1 Western.

6508/8309
CSO: 1866/48

UDC 551.243.13:629.78 (282.251)

METHODS OF STUDYING ICE FIELDS AND UNDERGROUND WATER IN EASTERN PAMIR

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 6, Nov-Dec 86 (manuscript received 6 Mar 86) pp 48-58

[Article by A.G. Topchiyev, All-Union Scientific Research Center "AIUS-Agroresursy," Moscow]

[Abstract] There is a need for rapid methods of estimation of natural water resources and location of sources of underground water using air and space photograph information and modern automated processing methods. Ice fields of various types are considered an easily formalized characteristic in organizing interactive automated space photograph processing. Criteria selected for search and evaluation include the genesis, morphometric parameters, dynamics of processes of formation and position of ice fields in plan and elevation. Automation of the interpretation of ice fields and programmed methods of processing data files thus produced allow elimination of the subjectivism which can occur in visual interpretation of space photographs, permitting collection of reliable information for the system of interpretation. The method was applied to Eastern Pamir and, supplemented by traditional approaches, allowed cataloging and mapping of ice fields with differentiation by feeding type, investigation of conditions of formation and analysis of causes of ice field process dynamics over a number of years. The quantitative interpretation methods suggested allow ice fields to be used as estimation criteria for generation of an inventory of natural underground water resources. Analysis of dynamic parameters over several years can establish the influence of seismogenic factors on ice field formation conditions where water is supplied by deep circulation. Figures 5; references 9: Russian.

6508/8309
CSO: 1866/48

UDC 629.78:626.87.631.4

EXPERIENCE IN APPLYING METHOD OF MATHEMATICAL-CARTOGRAPHIC MODELING OF SOCIOECOSYSTEMS USING SURFACE AND AEROSPACE INFORMATION ON EXAMPLE OF LVOV OBLAST, UKRAINIAN SSR

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 6, Nov-Dec 86 (manuscript received 17 Dec 85) pp 59-64

[Article by G.A. Bachinskiy, Lvov Division, Institute of Economics, Ukrainian Academy of Sciences]

[Abstract] The method of mathematical-cartographic modeling of socioecosystems using both surface and aerospace information is among the most promising methods presently used to solve the problem of balancing the interactions of society and nature. Expedient control of social-economic development of cities, administrative regions and oblasts requires that models of the corresponding socioecosystems be used to play out various versions of development to select the optimum version based on socioecologic criteria. This requires mathematical models allowing computer determination of the functional structure of the socioecosystem. The method of mathematical-cartographic modeling of socioecosystems was developed by the authors and first applied to optimization of land utilization in Lvov Oblast. A 1:100,000 scale atlas of natural conditions for the oblast was created, a socioecologic scientific generalization of the area. Mathematical-cargographic modeling of the socioecosystem utilizing remote sensing data was found to be an effective method of socioecology, allowing study of the interaction of human society and nature. References 9: Russian.

6508/8309
CSO: 1866/48

UDC 535.361.2

INFLUENCE OF LIMING ON SOIL SPECTRAL BRIGHTNESS COEFFICIENT

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 6, Nov-Dec 86 (manuscript received 5 Nov 85) pp 84-88

[Article by Yu.K. Ross, A.A. Galinis, T.A. Nilson and K.Yu. Ross, Institute of Astrophysics and Atmospheric Physics, Estonian SSR Academy of Sciences, Tartu; Vezhaych Branch, Lithuanian Scientific Research Institute of Agriculture]

[Abstract] It is difficult to monitor the quantity of lime applied to the soil in liming. The question arises, can the change in reflectance of the soil caused by application of lime be used to monitor the quantity of lime applied. Field experiments were performed on 6 and 7 May 1984 on loam, sandy, light and dark peat soils, with lime applied through a screen at rates of 0, 1, 2, 4, 6, 8 and 10 t/ha over 1 square meter test areas. The influence of rainfall was considered by flooding the areas after application of the lime, followed after 15 minutes by remeasurement of reflectance. The results showed that aircraft or helicopter measurements of reflectance can be used to determine the quantity of lime applied to soil with satisfactory accuracy if the type of soil, previous soil cultivation history and moisture content are known. Figures 6; references 4: 2 Russian, 2 Western.

6508/8309
CSO: 1866/48

UDC 528.813+631.1

DETERMINATION OF SOIL MOISTURE CONTENT FROM MEASURED RADIO BRIGHTNESS TEMPERATURE CONSIDERING BONDED MOISTURE

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 6, Nov-Dec 86 (manuscript received 18 Feb 86) pp 89-91

[Article by P.P. Bobrov, V.V. Krylov, R.A. Kulmametev, B.I. Pavlenko, T.A. Sologubova and V.S. Etkin, Moscow State Pedagogical Institute imeni V.I. Lenin; Institute of Space Research, USSR Academy of Sciences, Moscow; Omsk Pedagogical Institute]

[Abstract] Studies were performed on chernozem soil from Omsk Oblast. The dielectric permeability of the soil, as a mixture of air, water and solid particles, was determined from the radio brightness temperature of the soil measured at the nadir for various moisture contents. A field experiment involving remote sensing of the soil with a radiometer was performed. This experiment indicated that at 1.5 cm wavelength the radio brightness temperature depended directly on moisture content in a very thin surface layer. The moisture content determined with allowance for bonded water was closer to the experimental value of moisture content in the 0-1 cm layer than the moisture content determined disregarding bonded water. Figure 1; references 6: 5 Russian, 1 Western.

6508/8309
CSO: 1866/48

UDC 502.3:629.78

TEXTURE ANALYSIS OF IMAGES WITH LEARNING ON A TEST SECTION

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 6, Nov-Dec 86 (manuscript received 16 Dec 85; after revision 28 Mar 86) pp 92-96

[Article by T.V. Pyatibrat and D.A. Usikov, Institute of Space Research, USSR Academy of Sciences, Moscow]

[Abstract] The purpose of this work was to suggest a precise definition of the term "texture" and describe fast computer methods and equipment for image texture analysis. Texture is taken to mean the spatial-statistical properties of images, where "statistical" refers to image functions which are preserved after application of a certain set of transforms. The concept of texture is studied using binary images in which brightness can take on only two values. The methods of texture analysis presented are oriented toward detailed analysis of images, since they permit any image described in terms of picture elements and their mutual location to be analyzed. A set of programs is written in FORTRAN for the SVIT terminal system to implement the fast texture analysis algorithms suggested. Figures 2; references 6: Russian.

6508/8309
CSO: 1866/48

UDC 528.7:681.3

ANALYSIS OF DIRECTIONS OF LINEAR IMAGE ELEMENTS BY STRUCTURE-ZONAL METHOD

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 6, Nov-Dec 86 (manuscript received 28 Aug 85) pp 97-100

[Article by V.A. Kottsov, Institute of Space Research, USSR Academy of Sciences, Moscow]

[Abstract] The method of structure-zone transformation of video information is one possible means of increasing the effectiveness of studying the Earth from space. The essence of the method is analysis of the characteristics of the spatial structure of an object onboard the spacecraft, with formation of images which code changes in structural characteristics over the field of vision. This article studies the specifics of one particular case, structural analysis of the directions of linear elements, as in analysis of the directions of wide wave action on water surfaces, studies of the dynamics of glaciers based on observations of cracks on their surfaces, and determination of the direction of motion of eolian relief forms. A test object was used to check the effectiveness and analyze the peculiarities of application of the procedure, consisting of 6 fields, each of which contained an image of the same ocean wave fragment with successive rotation by intervals of 30°. The experiments demonstrated that the quality of the image was increased by additional screening of the central portion of the spectrum, equal in size to the scanning beam. Three images produced are presented, illustrating the false color representation of the different directional patterns. The experimental results confirm the desirability of using structure-zone representation of video information to analyze the directions of linear texture elements. Figures 4; references 8: Russian.

6508/8309
CSO: 1866/48

UDC 528.7:681.3

STATISTICAL EVALUATION OF CHARACTERISTICS OF FOREST OBJECTS FROM AIR AND SPACE PHOTOS

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 6, Nov-Dec 86 (manuscript received 25 Sep 85) pp 105-112

[Article by R.I. Elman, L.A. Kuzenkov and N.A. Aparinova, "Lesproekt" All-Union Aerial Photo and Forest Utilization Association, Moscow]

[Abstract] An experimental automated system for processing of air and space information on forests has been developed by the authors' association. The system is designed for constant utilization in scientific and production practice employing methods of statistical evaluation of the characteristics of forest objects. The REGION technology based on these methods allows automatic determination of forest valuation characteristics of forested areas from air and space photographs. This article describes the method of statistical evaluation of characteristics of natural objects, and presents examples of such evaluation of forested areas. References 10: Russian.

6508/8309
CSO: 1866/48

UDC 528.8.04+528.88

CONTROL OF STATUS OF NATURAL OBJECTS USING REMOTE SENSING

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 6, Nov-Dec 86 (manuscript received 18 Jul 85) pp 113-116

[Article by L.A. Vedeshin and V.V. Yegorov, Institute of Space Research, USSR Academy of Sciences, Moscow; "Intercosmos" Council, USSR Academy of Sciences, Moscow]

[Abstract] Timely control of the status of natural objects using remote sensing data is particularly important in agriculture and environmental protection. An approach based on analysis of the entire closed loop of control of the status of natural objects using the theory of automatic regulation is quite attractive and promising. This article describes the control loop of the current status of natural and anthropogenic objects on the Earth. Problems of evaluation of the accuracy of control of the status of natural objects are discussed. Tasks for future investigation include determination of the transfer functions and amplitude-frequency characteristics of all elements in the system, determined largely by the characteristics of the natural object itself and the nature of the controls applied. Figures 2; references 5: Russian.

6508/8309
CSO: 1866/48

GORBACHEV VISITS BAYKONUR

Moscow Domestic Service in Russian 1400 GMT 13 May 87

[Text] Mikhail Sergeyevich Gorbachev, general secretary of the CPSU Central Committee, visited the Baykonur cosmodrome and the town of Leninisk, Kazakh SSR, 11-13 May. During his stay in these places, Comrade Gorbachev had many meetings and conversations with scientists, specialists, workers and technicians and also with the residents of the town. The CPSU Central Committee general secretary laid flowers at the memorial to Vladimir Ilich Lenin. Comrade Gorbachev saw examples of space technology on show at the cosmodrome. It is from this unique research and testing complex that Soviet manned and automatic spacecraft are launched. It is from here that the launch of the Mir space station, now working in space, was carried out. Leninisk, a modern town bearing the name of the leader of the revolution and the administrative center of the cosmodrome, has grown up here alongside the laboratories, the test rigs, and the launch pads. There was an exhibition of space apparatus used for the purposes of the national economy, for communications, television, meteorology, and space research. At present work is in progress at the cosmodrome to prepare for the launch of a new general purpose carrier rocket capable of putting both multiple-use orbital craft and large-size spacecraft for scientific and economic purposes into low orbit, including modules for long-term stations.

During the conversations that took place with development and test engineers, it was noted that cosmonautics is at the forefront of scientific-technological progress, embodying the latest achievements of many spheres of our country's science and technology. It has made it possible to expand the frontiers of human activity, and has joined virtually all the world's countries in a unified network of communications and television. It has opened up great opportunities for deeper study of the natural resources of our planet, for research into atmospheric and weather phenomena, and for the manufacture of new, super-pure materials. In this connection, the importance of the further development of space technology, primarily for peaceful ends, and of the expansion of international cooperation in the field of space research was stressed.

During his meetings, Mikhail Sergeyevich Gorbachev devoted great attention to the social and everyday conditions for workers of the cosmodrome. He visited the House of Pioneers, a store, a sports complex, and other

facilities and had conversations with the residents of the town. It was noted that people are living and working here in severe climatic conditions. In connection with this, questions of the working people's welfare and leisure assume particularly important significance. Much has been done in the town of Leninsk to satisfy the increasing requirements of the population. However, there are also quite a number of unsolved problems. Party and soviet organs, those in charge of enterprises and organizations have been instructed to take the social sphere in hand and to devote more attention to these questions.

All those with whom the CPSU Central Committee general secretary had conversations spoke of full support for the course aimed at accelerating the country's social and economic development worked out by the Central Committee April Plenum and by the 27th party congress. The collectives of Leninsk enterprises have actively joined in the restructuring of all aspects of life. They work at a tense pace, with good and lively mood, struggling persistently to fulfill the high socialist pledges in honor of the 70th Great October Socialist Revolution anniversary.

A meeting between Comrade Gorbachev and representatives of the workforces of the cosmodrome and of the town of Leninsk took place at the local palace of culture. Mikhail Sergeyevich Gorbachev's speech is published.

Fitter Arbekov, builder Chernyavskiy, cosmodrome veteran Shumilin, secretary Kormovshchikova of the polyclinic's Komsomol organization, and others spoke at the meeting.

Comrade Gorbachev visited the memorials at the cosmodrome linked with the work of Sergey Pavlovich Korolev and Yuriy Alekseyevich Gagarin.

Together with Mikhail Sergeyevich Gorbachev at the cosmodrome were: Comrade Zaykov, member of the Politburo and Secretary of the CPSU Central Committee; Comrade Chebrikov, member of the CPSU Central Committee Politburo and chairman of the KGB; Comrade Sokolov, candidate member of the CPSU Central Committee Politburo and USSR Minister of Defense; Comrade Maslyukov, deputy chairman of the USSR Council of Ministers; Comrade Marchuk, president of the USSR Academy of Sciences; Comrade Kolbin, first secretary of the Kazakhstan Communist Party Central Committee; Comrade Nazarbayev, chairman of the Council of Ministers of the Kazakh SSR; Comrade Auyelbekov, first secretary of the Kzyl-Orda Obkom; and several officials in charge of union ministries and departments.

/12223
CSO: 1866/82

NEW SPACE EQUIPMENT DISPLAYED

Moscow TASS in English 1430 GMT 13 May 87

[Text] Moscow May 13 TASS--Mikhail Gorbachev, general secretary of the CPSU Central Committee, was staying at the Baykonur space launch facility and in the city of Leninsk, Kazakhstan, on May 11-13.

During the visit Mikhail Gorbachev had a big number of meetings and conversations with scientists, specialists, workers, engineers and technicians, and residents of the city.

Mikhail Gorbachev saw samples of space equipment at the launch facility where work is in progress now for the blast-off of a new versatile booster rocket capable of putting into near-earth orbits re-usable orbiters and large-sized spacecraft used for scientific and national economic purposes, as well as modules for space stations to be used over long periods of time.

Mikhail Gorbachev had a meeting with members of work collectives of the Baykonur Cosmodrome and the city of Leninsk. His speech during the meeting will be published.

/12223
CSO: 1866/82

GORBACHEV SPEECH AT BAYKONUR COSMODROME

Moscow PRAVDA in Russian 14 May 87 pp 1, 2

[Excerpts] Dear Comrades! Permit me to cordially greet you on behalf of the CPSU Central Committee and the Soviet Government, and to thank you for your shock labor, for the persistence, and for your creative labor on behalf of our homeland.

All of us Soviet people have always pronounced the word "Baykonur" with special emotion. It has become a symbol of our homeland's greatest exploit — a triumph of Soviet science and the great potential of the socialist social system.

Here, in the boundless steppes of Kazakhstan, one experiences a sense of pride in the intellect and deeds of Soviet people and in our Soviet fatherland. It is here one senses more strongly the greatness and might of the Land of October and its immense achievements which have crowned the 70-year path of the peoples of our great multinational state since the October Socialist Revolution.

It was from here mankind first stepped into outer space, opening a new page in the history of civilization. It was from here at Baykonur, in October 1957, that the first artificial earth satellite — a symbol of revolutionary science and technology — was put into orbit. It was from here, on 12 April 1961, that man's first flight into space was carried out — the remarkable flight by our countryman Yuriy Alekseyevich Gagarin. These are all great landmarks in the development of Soviet science and technology.

Created by the labor and talent of Soviet scientists, workers, engineers, and military specialists, the unique scientific research testing complex is the true embodiment of Lenin's dream of turning our state into a great industrial power.

In essence what is concentrated here is the intellectual capacity and the final results of the work of many dozens of our country's scientific research and design organizations and major machine-building enterprises. It is a real testing ground for advanced engineering thinking. I would say that in all main areas it is equipped with the most up-to-date science and technology.

I would like to single out in particular the following: Everything here at the space center, from the most complex launch facilities, testing facilities, and laboratories to the powerful carrier rockets, space apparatus, and their life support systems equipped with modern computers and highly sensitive instruments — all this has been produced by us in the USSR. It is all high-quality and state of the art technology.

Once again a simple but very important question comes to mind: Why do we at times try to acquire even simple items from abroad if we are today capable of resolving such vast, large-scale and complex tasks? Everything seen here leads once again to the deep conviction: There is no reason for us to go abroad, hat in hand in this way. [paragraph continues]

No embargoes, no ban imposed by certain foreign circles on selling us technology and equipment will slow down the development of our country or the implementation of the great social and economic plans connected with restructuring and the acceleration of our economy.

This once again convinces me of the need to give every support to our science, our scientific intelligentsia, engineers, and designers.

On the other hand, it is necessary to strengthen demands, to put an end to a kind of inferiority complex, to actually develop the immense scientific potential we have accumulated over the 70 years of Soviet power. This is within our reach; and this, Comrades, is one of the central tasks of restructuring.

The worker Arbekov has spoken here, and I support him. Everyone must do more in their work and carry out their job honestly. Less talk and more action — this will be restructuring. I would also like to appeal to you, Comrades, to take a good look at your work. I have already spoken about your great achievements, and you are entitled to be proud of them; the country, too, is rightly proud of them. This is a generally recognized fact, and we note your outstanding contribution.

But if only that were said at our meeting, and if no attention were drawn to the weak points in your work, I believe you would not even understand me. [paragraph continues]

Some people would begin to have doubts as to whether the truth is reported to the CPSU Central Committee general secretary. What impressions would he take back to Moscow with him?

First of all, I basically knew what was happening here before I left Moscow. We have quite good information. This made it possible for us to also see the weak points in your work, those connected with the implementation of the latest tasks. It is wrong that problems of everyday life and the sociocultural conditions of the working people engaged in resolving immense tasks have to some extent been put in the background.

Second, I have acquainted myself with the situation on the ground. I have received a complete picture. The conclusion is clear: There are shortcomings and oversights. It is therefore necessary to make good the lost ground. Bottlenecks must be opened, and the new problems which have arisen must be resolved. We have adopted a number of CPSU Central Committee and government measures to support your efforts. Now it is up to you.

We have substantially increased capital investment for housing construction, and the construction of healthcare facilities and food industry enterprises, for improving the supply of heat and water and transport services, and for the construction of schools and children's preschool establishments and cultural amenities. Set about this work as one man!

Why am I talking about this? Even in smaller amounts, the funds allocated in previous years were not assimilated. It is therefore necessary to do some thorough work, Comrades. At meetings and conversations in the city I said that we would monitor this. Everybody must clearly understand that Baykonur has been established to last a long time, even forever.

We have gained much from research aimed at the peaceful conquest of space. We are also faced with tasks which we must comtemplate. How are we to make the yield from space more weighty both for science and for the whiole national economy? This is the practical task with which we are faced today in all its magnitiude. We must switch more boldly from experiments and research work to the planned and wide-ranging application of existing opportunities in the interests of the country's socioeconomic development. From the USSR Academy of Sciences, the USSR State Committee for Science and Technology, the USSR Main Space Administration, [Glavkosmos] and all the ministries and departments concerned we expect considered and viable proposals on expanding the application of the achievements of space technology in the national economy.

CSO: 1866/83

DUNAYEV INTERVIEWED ON SPACE SERVICES OFFERED BY USSR

Moscow EKONOMICHESKAYA GAZETA in Russian No 10, Mar 87 p 20

[Interview by Ekonomicheskaya Gazeta Correspondent V. Virkunen with A. I. Dunayev, chief of the Main Directorate for the Development and Use of Space Technology for the National Economy and Scientific Research: "Space: An Arena of Peaceful Cooperation"; under the rubric: 'An Interview at the Reader's Request'; first paragraph of text appears as source introduction]

[Text] Our reader from the city of Khasavyurt in the Dagestan ASSR M. Devletmurzayev asked us to talk about the satellite-launch services provided by Soviet organizations on a commercial basis to our foreign partners. EKONOMICHESKAYA GAZETA correspondent V. Virkunen asked the chief of the Main Directorate for the Development and Use of Space Technology for the National Economy and Scientific Research, A. I. Dunayev, to comment on the letter.

[Question] Aleksandr Ivanovich, from all appearances, the services the Main Directorate for Space of the USSR provides to foreign firms and organizations are not at all limited to merely the launching of artificial Earth satellites on a commercial basis, are they?

[Answer] That's absolutely correct. The launching of artificial Earth satellites that belong to foreign nations, organizations, and firms is a comparatively small part of the work the Main Directorate for Space does on a commercial basis. The directorate is called upon to conduct and coordinate a whole complex of measures associated with the development and use of space technology for various branches of the national economy and scientific organizations of the Soviet Union. But along with running operations that are of interest to many of the ministries and agencies of our country and to the scientific organizations of the Academy of Sciences of the USSR and of the union republics, the directorate has responsibilities that are associated with the implementation of agreements made with foreign nations, organizations, and firms.

An arrangement with our foreign partners enables us to launch space vehicles used for various purposes and, of course, communications satellites. With the dramatic increase in the exchange of information that occurs on levels that include countries and continents, it is difficult to imagine how we would be able to cope with the matter without communications satellites.

Often, a party in Moscow dialing a number in Vladivostok, Paris, Ottawa, or New York does not even suspect that the call is reaching the other party by way of communications satellite. Space communications have become routine. Functioning well in the USSR right now is the Orbita communications system, designed to handle television programs and telephone communications. It includes about 100 ground stations as well as Raduga- and Gorizont-type satellites that are used to transmit two Central Television programs across the entire expanse of our country.

[Question] As you already mentioned, communications satellites are by no means the only type of space vehicle included in the launch services provided by the directorate. Would it be possible for you to name the functional purposes of the satellites that Soviet rockets can launch?

[Answer] The Directorate for Space can, at any country's request, arrange for the remote sensing from space of that country's national territory, a service that offers a broad range of possibilities in many economic sectors. Satellite photos can easily track regions exhibiting concentrations of joints and fractures in the earth's crust, along which ore-bearing lava rose to the surface in prehistoric times.

But it is not just geologists who are interested in satellite photos. No less of an interest is displayed by those who work in agriculture. With photographs taken from orbit, soil conditions can be monitored, vegetation type can be determined, diseased vegetation can be distinguished from healthy, and crop and pasture conditions can be evaluated.

Remote-sensing techniques developed in the USSR hold much promise for the exploration and working of reserves of nickel-iron and managnese nodules as well as other minerals on the coastal shelf.

A space probe can do things like track the formation of atmospheric circulations, accurately determine the condition and temperature of the ocean, and, thus, predict the weather with a high level of probability. From orbit, ice conditions in polar waters can be ascertained, the thickness of the ice determined, and recommendations issued to ships regarding the best routes.

The Soviet program of broad-based international cooperation in the peaceful use of man's achievements in space means offering assistance in the launch of any space vehicle to be placed into orbit for scientific or commercial purposes. We have already launched 30 different satellites by way of agreements reached with other countries, among them India, France, and Czechoslovakia. In an agreement reached between the All-Union Foreign Trade Union Litsenzingtorg and India's Organization for Space Research, the next of India's satellites, which will be used for the remote sensing of that country, is now being prepared for launch.

In January of this year, a group of Soviet specialists traveled to India to help prepare the satellite. In the second half of this year, the space vehicle will move to the Soviet spaceport at Baykonur. Launch is scheduled for

September or October. The satellite will be placed into a sun-synchronous polar orbit.

We are prepared to launch Inmarsat space vehicles used for ship-to-ship maritime communications. Many other proposals have been made regarding the launch of other types of satellite.

Considering our many years of experience in the operation of spacecraft used for the most diverse of purposes, we can guarantee on-time launch of a satellite into any orbit with predetermined parameters. We have the necessary facilities for that. Soviet vehicles are highly reliable and have worked for years without a single failure.

[Question] But failures do occur. Would it be possible for you to give us some examples?

[Answer] Space technology is complex, and for now it is difficult to avoid them completely. But we are striving to keep them down to as few as possible. I cite as an example the well-known Proton launch vehicle. We have used it for more than 20 years, and it is capable of lifting a payload of up to 21 tons into various orbits in space. The series is reliable, has been tested many times over, and has fully performed all its missions involving the launch of space vehicles into an Earth orbit or to other planets in the solar system. The reliability index of Soviet vehicles is considerably higher than that of foreign space-transportation systems, whether they be one-time-use or reusable.

It is common knowledge that the launches of the reusable Space Shuttle transport vehicle (USA) and the Ariane launch vehicle (European Space Agency) have been associated with a large number of failures and losses of expensive satellites. In the West now, claims are often made that, they say, the Soviet Union is exploiting the situation involving the series of launch failures associated with the Space Shuttle and the Ariane vehicle by offering its services for the launch of commercial vehicles. This is not so. Our proposals are motivated by a desire to create international cooperation in the peaceful development of space, to more effectively use the Soviet Union's experience in the operation of space systems, and to make space the property of other peoples and states.

To that should be added that we have been participating in international space ventures for a number of years now, and our country has proven itself a reliable partner.

On the other hand, one cannot, of course, totally ignore world conditions. We most certainly have a right to count on receiving specified revenues, but we do not always seek mere material gain in the form of money. We see a mutual gain also in the exchange of instruments and components, scientific information, technologies, etc.

No one is immune to failures. I am not asserting that in the future everything will go without a hitch. Equipment is equipment. If a commercial satellite fails, the directorate is prepared to provide compensation commensurate with

that now provided in international practice or to provide another launch with favorable terms.

[Question] You noted that the Directorate of Space has proposals from organizations and firms of many countries, including the USA and England, which contain requests involving launches of satellites of varying purpose. But these proposals have yet to be implemented. Why?

[Answer] In fact, many countries, organizations, and firms have approached us with requests concerning launches of satellites with commercial or scientific missions. But we cannot carry them out, and for one reason: the government of the United States has placed a strict embargo on the shipment into the USSR of space vehicles that include even one component made in the USA.

With the United States the leader among Western countries in the field of space research, there are, then, I think, few satellites that do not use American instruments and components. One may conclude from this that the United States, by its embargo, has permanently closed off the possibility of developing international cooperation between the East and the West in the peaceful development of space.

American officials justify such a thick-headed ban by saying that, well, the Soviet Union will right then and there "rob" the United States of portions of its technology and will reveal many of its secrets. What can we answer to such a--to put it mildly--groundless position?

In the first place, with our widely known achievements in the development of science and technology, among them the development of outer space, the Soviet Union is obliged least of all to American technology. We develop the most advanced equipment, which is second to none and is often superior to the best foreign counterparts.

In the second place, we say to our opponents: your satellites are not subject to customs inspection and will travel to the launch site in a closed and sealed container. The client is given every opportunity to remain with his satellite right up to the start-up of the launch vehicle. All we need to do is ascertain that the satellite is in working order.

As you can see, burglary is completely precluded, but they still say to us "No!" From all appearances, it is not a matter here of technology, but of politics. Militant, pathological anticommunism is striving with all its might not to allow peaceful cooperation among nations in space.

That embargo is aimed not at the USSR, but primarily at states, organizations, and firms that do not have their own space technology. I will give just one example. The organization Inmarsat is ready to sign an agreement with the Directorate of Space concerning the launch with a Soviet launch vehicle of a satellite that will provide communications with maritime vessels in the world ocean. But the unbending position of the White House is preventing the implementation of this mutually beneficial project.

[Question] Many Western scientists and specialists assert that the cost of launching a satellite in the Soviet Union is lower than the cost of launching spacecraft with the Ariane and Shuttle space-transportation systems. Is that so?

[Answer] Well, these assertions are not far from the truth. One cannot say, without considering a whole series of factors, that the USSR launches satellites at the lowest cost. The fact that we have placed our main vehicle, Proton, into production, that we have standardized many units and assemblies, that we have substantially lowered the cost of this product while increasing its reliability, can speak for the lowering of launch costs as a whole, although we also take into account the commercial market.

[Question] Tell us, please, about space technology. What does it provide to the national economy, and what prospects does it open for international cooperation?

[Answer] Space technology means using conditions of microgravity to obtain uniquely propertied substances that would simply be impossible to obtain with the Earth's gravity. Showing great promise for this are unmanned spacecraft and orbital stations, and, of course, the orbital station Mir. Mir has docking facilities for five spacecraft-modules that weigh 20 tons each and have the finest control systems and heavy-duty, solar-rechargeable power systems.

These are, in essence, not vessels, but genuine laboratories and shops that produce the most extraordinary metal alloys, semiconductors with unique properties, crystals of virtually unlimited size, and medical preparations that are impossible to make on Earth. Imagine this picture: a shop-module docks with the station, the crew loads the raw materials into the furnace or the industrial units, switches on a program, and then the module leaves the station. In independent flight, with a complete absence of vibrations and micro g-loads, technological processes take place that are unthinkable with the Earth's gravity.

It is here that grand prospects for broad-based international cooperation unfold. Today, upon request, we can already take various components provided by foreign countries, as well as capsules and containers prepared for experiment, and perform certain technological processes in orbit. If the scale of the requested processes is large enough, we are prepared to allot an entire satellite-module for the work.

[Question] And the final question. Would it be possible for you to tell us about flights that are being planned for international crews?

[Answer] Certainly, especially since we have set up all the conditions for such flights. Two Soviet stations are now functioning in orbit: the Salyut-7, which has been flying for more than four years now, and Mir, which has been operating for more than a year. Salyut-7 continues work that involves test of service life, and Mir recently accepted its next space shift--the crew of Yu. Romanenko and A. Laveykin.

As already reported, a Soviet-Syrian space flight will take place in July of this year. The two Syrian cosmonauts M. Faris and M. Habib are close to completing their preflight training at the facilities in the small town of Zvezdnyy. Then, in mid-1988, a Soviet-Bulgarian space expedition is scheduled. The Bulgarian cosmonauts Aleksandr Aleksandrov and Krasimir Stoyanov recently arrived in Zvezdnyy and have already begun their training. We continue our peaceful, mutually beneficial cooperation in space with France. According to agreement, an uninterrupted, 30-day flight with a Soviet-French crew is scheduled for late 1988. We are all quite familiar with one of the French cosmonauts--Jean-Loup Chretien. The second candidate for the flight is Michel Tognini.

Every flight with an international crew has specific national features. Syria is interested in studying and identifying the natural resources within its boundaries. Bulgaria has outlined a broad program of medical and biological experiments. France intends to conduct equipment-related experiments in space.

Flights with international crews are the most important part of our work in the development of broad-based international cooperation in space. We are for cooperation that is peaceful, equitable, and mutually beneficial, that is without any kind of discrimination, and that bears some tangible good to nations. Counterbalancing the sinister, widely proclaimed Strategic Defense Initiative, or more precisely, "Star Wars," we will move forward, strengthening and upholding our program of star peace.

13227
CSO: 1866/65

GDR'S CONTRIBUTION TO INTERCOSMOS

Moscow EKONOMICHESKOYE SOTRUDNICHESTVO STRAN-CHLENOV SEV in Russian No 1, Jan 87 pp 90-95

[Article by Klaus Grothe: "GDR's Contribution to the Peaceful Development of Space"; under the rubric "At the Forefront" (Krupnym planom), first paragraph in boldface in source; second paragraph appears as caption beneath photo, third paragraph in boldface in source]

[Text] Space research reflects the rather profound integration of the national research potentials of CMEA member-countries. Elaborate space facilities serve as a powerful impetus to the development of key technologies.

Klaus Grothe, secretary-general of the Academy of Sciences of GDR and chairman of the National Coordinating Committee for Intercosmos.

Addressing the XI Congress of SEPG, E. Honecker emphasized this: "Science in the German Democratic Republic is keeping pace with the times. It sets its own goals, based on our social and, above all, economic needs for strengthening socialism. It takes an active part in the global process of continuing the expansion of the boundaries of our learning in natural science and technology." GDR scholars are also actively contributing to the implementation of a program of multilateral cooperation among socialist countries in the study and use of outer space for the peaceful purposes of Intercosmos. These challenges are addressed in the Integrated Program of Scientific and Technical Progress for CMEA Member-Countries Up to the Year 2000, since space research increasingly helps solve national economic problems.

The Soviet Union steadily and unswervingly emphasizes the need for using space for peaceful purposes. The single-minded work of the USSR in this direction has prepared the way for fruitful cooperation, something that has found expression primarily in the Intercosmos program. Cooperation within its framework is developing in the spirit of a proletarian, socialist internationalism. Free of charge, the Soviet Union has provided its brother countries with vehicles (rockets and satellites), as well as elaborate and expensive facilities for launches and flight control.

Performing separate studies agreed upon within an international plan, countries participating in the Intercosmos program bear a proportionate amount of the expenses. Their findings are accessible to all interested participating countries.

Right now, research is being conducted within the Intercosmos program in the following fundamental areas: space physics, which includes materials science; space meteorology; space communications; space biology and medicine; and remote sensing with aerospace equipment.

A permanent working group is toiling in every area of research. Such groups are engaged in the preparation of scientific programs and projects and in the organization of collaborations, as well as in the planning, negotiation, and monitoring of research missions based on multilateral agreements.

Space research is meeting the exacting demands made of science today, specifically in the Integrated Program of Scientific and Technical Progress for CMEA Member-Countries Up to the Year 2000, signed 18 December 1985 in Moscow. In the first place, space research reflects the rather profound integration of national research potentials of brother countries. In the second place, elaborate space facilities serve as a powerful impetus to the development of key technologies. And in the long run, this will be the most important criterion in the selection of space projects. They will play a deciding role in the research in which GDR participates--for example, in the area of space physics.

Space Physics: New Problems, New Resources

This is the traditional sphere of space research. Man-made spacecraft have enabled the first direct measurement of physical parameters in near-Earth space.

Since the days of the launch of the IK-1 satellite, GDR has participated in studies of the physical processes of the upper atmosphere with an eye to modeling the dynamic and energetic interactions there as well as studying the structure of the magnetosphere and the ionosphere. This interaction between the sun and the Earth also has a direct effect on circulation in the lower layers of the atmosphere, i.e., on weather patterns, something that is confirmed by Intercosmos experiments, as well as by a bank of higher-quality satellite and rocket measurements.

The development of deep-space probes has enabled us to determine the physical parameters of the planets and the satellites of our solar system, something that was impossible before from Earth. Substantive data on the physics and chemistry of the planets have been gathered through the use of observation techniques of space meteorology and remote sensing of the Earth in the study of planetary bodies and their atmospheres, which has been supplemented by the use of unmanned landers, as well as through direct measurements, soil samples, and chemical analyses. Special studies of the lunar soil samples brought back to Earth in the early 70s by unmanned Soviet spacecraft and passed on for analysis to participating countries have raised the level of our knowledge.

The Venera-15 and Venera-16 deep-space probes, launched in mid-1983, achieved orbit of Venus within four months, in October, and circled that planet on a diurnal schedule. The instrument complex developed by Soviet specialists for both probes was augmented by an IR-Fourier spectrometer developed in GDR and installed in a hermetically sealed compartment on the probes. This instrument enabled precise examination of Venus radiation in the 6-38 μm range. The data recorded was preliminarily processed in a microprocessor of GDR manufacture and was transmitted to Earth.

Scientific organizations and institutes of GDR and other countries participating in the Intercosmos program, along with a number of Western European partners, are planning to take part, under the direction of the Academy of Sciences of the USSR, in an extremely interesting project involving the study of the Martian satellite Phobos. GDR will make available a magnetometer as well as a laser technique involving the mass-spectrometric study of the upper layers of the surface of the Martian satellite. For the Vega program, which studied Halley's Comet in March 1986, GDR developed an image-processing system (including software) for interpreting data transmitted from Vega-1 and Vega-2.

In space physics--in particular, in satellite geodesy--GDR specialists have achieved widely recognized success both in determining the positions of artificial Earth satellites and in solving global geodesic problems.

The development and refinement of laser measurement systems, the theoretical and experimental studies aimed at improving the modeling of satellite trajectories, and the development of computer programs have prepared the way for the Potsdam observation station's active participation in international satellite geodesy projects.

Physical processes in liquids and gases are drastically changed as a result of the dramatically reduced gravity aboard artificial spacecraft (microgravity). This is a source of new experimental possibilities in material sciences research (for example, areas like thermodynamics, hydrodynamics, diffusion, and phase -boundary effects). In the Intercosmos program, GDR is helping develop the foundations of this relatively young scientific discipline. Model substances are being used predominately to study physical processes that will, in the future, be of interest to the national economy--outcomes involving, for example, ground-based technologies and the production of special materials in space. In this vein, beginning with the Soviet-GDR spaceflight and extending to the present, Soviet scientists collaborating with other scientists have used Soviet-made Splav-10 and Kristall units installed on board Salyut-6 and also on the ground to conduct and analyze ten separate experiments. As a result, solutions have been found for the ground-based manufacture of crystals whose properties are better suited for practical application as well as for fundamental research in the area of solid-state physics.

Moreover, GDR institutes have developed techniques and instruments that measure the thermal behavior of outer-space furnaces and have been used to measure the Kristall furnace in two space experiments.

Achievements of Space Meteorology

The mission of space meteorology is to use meteorological rockets and satellites to determine the patterns of the processes that occur in the Earth's atmosphere, especially the troposphere and the stratosphere (up to a height of nearly 80 km), and dynamic interactions. Putting the findings to use and developing and gradually refining the methodological and technical aspects of the use of data obtained via meteorological rockets and satellites and a system of satellite communications--that is the direction subsequent space meteorological operations will take.

GDR has developed and introduced the WES-2 device for receiving signals from meteorological satellites. Only a small number were manufactured, primarily for export, and they have performed well in ship-board testing.

Researchers at the Academy of Sciences of GDR have, along with the Weather Service, developed a device for receiving signals that are transmitted at 665 kilobits/sec from meteorological satellites operating in the 1.7 GHz frequency range (S band). Thus, information from geostationary satellites and satellites that are circling the Earth in the region of the poles arrives several times a day, augments the basic data needed for compiling weather forecasts, and makes a substantial contribution to increasing their accuracy. A designated portion of the global weather map is transmitted daily by television. Data arriving from meteorological satellites, primarily on temperature distribution, are used in growing measure for the daily forecasts the GDR weather service provides.

GDR's Cooperation in Space Communications, Biology, and Medicine

From the very beginning of their collaboration in the Intercosmos program, GDR scientists have participated in the operations organized by the working group associated with space communications, in fundamental scholarly research, and in the development of the technical foundations for transmitting information with artificial Earth satellites. For example, preparatory work was done in setting up the international system of satellite communications, Intersputnik, which has been in operation since 1971. In recent years, GDR scientists have developed demodulators used for improving the reception of color television signals transmitted via satellite.

The suitability of transmission frequencies in the 10 GHz and 30 GHz ranges is now being studied for future satellite systems, with an eye to boosting transmitting power. An international experimental complex whose primary ground-based receiving station was built and put into operation not far from Moscow has been set up for that. GDR's contribution here was the receiving station, in which data are automatically recorded and processed by computer. Communications between this international complex and GDR's national measurement complex are through Intersputnik. For GDR, this means direct access to the findings of the experimental system.

GDR participates in work involving space biology and medicine, which study the effects of spaceflight on living organisms. It is also engaged in improving

flight conditions and further refining the means and methods of selecting and training cosmonauts and monitoring their health in space.

Thus, GDR institutes prepared experiments and developed instruments used on the Salyut-6 station to study auditory threshold changes in the cosmonauts and their physical condition in various phases of flight. They also refined psychological research techniques. The findings of these experiments not only are significant to the further development of space research, but also have applications in aviation medicine.

Remote Sensing--A Pressing Area of Interaction

The aim of operations involving remote sensing of the Earth is to create scientific-and-technical and methodological foundations for identifying types of surface features and their physical forms via spacecraft- or aircraft-based measurements of emissions in various spectral ranges and to use the information contained in remote sensing data in the interests of various branches of geoscience and the national economy.

After a multilateral working group was set up in the Intercosmos program in 1975, remote sensing became one of the primary areas of GDR's participation in the study and use of outer space. Here the work of GDR specialists was directed mainly toward developing the methodological and experimental foundations of the research. Since the bilateral intergovernmental agreement of 1978 between the USSR and GDR, our republic has been helping to develop a Soviet system of remote sensing services and to effect applications in the national economy.

At the international level, the development of multispectral technology is more advanced. The Karl Zeiss Jena Combine is widely known for its creation of multispectral photographic equipment--the MKF-6 multispectral camera, for example, and its updated or modified versions for long-term use on orbital stations (the MKF-6M) and aircraft (the MSK-4)--as well as for a complex of instruments for optical-analog image processing and evaluation.

This turned out to be valuable groundwork for the creation of methods and technology for processing and interpreting multispectral photographs in the interests of specific sectors. Close collaboration with Soviet institutes, as well as the participation of GDR users, produced instruments of rather high quality in a relatively short period of time. The experience, garnered with the help of synchronous research performed in space, aboard aircraft, and at ground testing sites--particularly in optical-analog processing and visual interpretation--has been consolidated in the Atlas of Multizonal Aerospace Photograph Interpretation.

Thanks to these scientific-and-technical researches and the methodological developments, some of the remote sensing data has found its way into the national economy in GDR, especially in the following areas: geoecology and regional planning, geodesy and cartography, geology, hydrology, environmental monitoring, and vegetational monitoring.

The Biosfera experiment, begun during the joint Soviet-GDR spaceflight in 1978 and continued as an international research program of visual/instrument observations aboard orbital stations, can be considered a supplement to photographic remote sensing and visual interpretation. For a number of phenomena on the Earth's surface, visual observation and immediate interpretation by a cosmonaut, as well as documentation with simple hand-held cameras, provide an enormous amount of information that can be of practical value.

Future work will involve improving the information content of remote sensing data. This will entail the development of algorithms and programs for specific consumers for more precise identification and definition of physical forms and a gradual transition to automated analysis of remote sensing data and to their inclusion in routine regional information systems.

One of the problems associated with the quantitative logging of small differences in the physical forms of specific targets--for example, in an ocean with various concentrations of impurities in the water--is the spectral distortion of the emissions coming from the targets, which is due to the atmosphere. With an eye to ascertaining a correction for the atmosphere's effect, especially over water bodies, multichannel spectrometers developed by GDR specialists have already been tested on the IK-20 and IK-21 satellites. As an extension of the joint work performed with countries participating in the Intercosmos program, the MKS-M multichannel spectrometer, developed in GDR, was lifted into space by the Soviet transport spacecraft Cosmos-1443. The spectrometer has been installed on the Salyut-7 orbital station and makes it possible to determine atmospheric parameters and the reflective properties of land and water surfaces. Joint expeditions are being organized for this experiment for the purpose of obtaining synchronous reference data for the scientific analysis of spectrograms and simultaneously received multispectral photographs.

In 1983, 1984, and 1985, GDR took part in Intercosmos-Chernoye More [Intercosmos-Black Sea] expeditions aboard the Soviet research vessel Professor Kolesnikov in which instruments were used both on a marine platform and in a aircraft-base laboratory. The simultaneous results of measurements made here and aboard Salyut-7 are being analyzed in various research institutes in the USSR, GDR, Bulgaria, and other countries participating in Intercosmos.

At the present time, progress in the area of remote-sensing hardware is apparent in the expansion of the spectral ranges being used. More than anything else, this involves the refinement of survey systems in the mid-frequency and thermal infrared ranges, as well as the expansion of the microwave range, with both passive radiometers and active imaging radar methods being developed. Subsequent research will involve determining information content and spheres of application associated with such radar images.

Scientific on-board instruments are matched to the tasks of an experiment, and in addition to various sensors and measurement systems, such instrumentation often includes electronic and optical instrument-making units as well as fine mechanics assemblies. In order to carry out vital scientific tasks, it was

necessary in GDR to develop some 150 on-board instruments for the research rockets, satellites, and spacecraft or stations being used, as well as a multitude of instruments and sites for receiving and analyzing information, along with test instruments for managing ground operations.

It should be emphasized that the Karl Zeiss Jena combine's example shows that the transition from design and technological experience of space instrument-making to production works well when industrial enterprises themselves participate in the development of on-board instruments.

Thus do our domestic science, technology, and production contribute to fruitful international cooperation in the peaceful development of outer space.

13227
CSO: 1866/77

DIRECTOR OF GLAVKOSMOS ON INTERNATIONAL SPACE CENTER

LD292236 Moscow TASS in English 1030 GMT 29 Jan 87

[Text] Moscow, 29 Jan (TASS)--An international space center should include pads for launching space objects, tracking stations and simulators for training cosmonauts, believes Aleksandr Dunayev, head of the Main Department for Development and Use of Space Technology for the National Economy and Scientific Research of the USSR (Glavkosmos).

Mikhail Gorbachev made the proposal for establishing the international center during his visit to India in November last year. The center would be created with the help of leading space powers for work under orders from developing nations on designing space equipment, including satellites to study natural resources.

Dunayev said in an interview with a TASS correspondent that the center could also become a place for training experts on space technology from developing countries and upgrading their skill.

Dunayev observed that the Soviet Union, one of the leading nations in space research, possessed substantial experience in developing, producing and using space technology.

"The possibilities of international cooperation in this field are unlimited, and Glavkosmos is prepared for broad cooperation with foreign firms, state and international organizations on a mutually beneficial basis."

Among the proposed services he mentioned the launching of foreign satellites by Soviet boosters and space photography of land. Soviet communications satellites of the Gorizont series could be hired. They would be placed in orbit selected by the customer.

Speaking on each of the directions of the "space services," Dunayev pointed out that Soviet booster rockets, offered for commercial launchings, proved their efficiency and reliability.

/9604
CSO: 1852/6

COMMENTARY ON U.S. AEROSPACE PLANE PROJECT

Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 3, Mar 87 pp 45-46

[Article by Colonel Yu. Okunev, Candidate of Technical Sciences: "The American Aerospace Plane Project"]

[Text] The passions which flared up around the catastrophe of the American reusable spaceship Challenger, which showed how complex space technology is and how delicately one must deal with it, have not yet eased, and a new campaign has started in the Western, primarily the American, press to influence public opinion. The public is being sold the idea that the development of another ambitious project--the aerospace plane (ASP)--is necessary. Judging from the information in the foreign press, they are talking about an aircraft capable of taking off and landing like an airplane at normal airports and flying in the upper layers of the atmosphere at speeds of up to 25,000 km/h (i.e., a suborbital system).

Initially, an aircraft of this type was called a TAV (Transatmospheric Vehicle), but in the spring of 1986 research on its creation was elevated to the status of a national program called the National Aerospace Plane Project. The hullabaloo surrounding this project reached such heights that even savvy Western reviewers began to express doubts about the American optimism, and a note appeared in the French journal "Air and Cosmos" under the title "Suborbital airplane or a new defeat for the USA?". But the military leadership of the USA takes a "hard" position on this matter. In April 1986 the Secretary of Defense together with NASA let seven contracts (for the powerplant and the airframe) with a term of 42 months to firms for a total sum of about 450 million dollars, which will provide for development of the key elements of the ASP's technology.

Powerplant contracts for 175 million dollars each were let to the firms Pratt and Whitney and General Electric. They face the task of developing and performing ground tests of the ramjet engines with supersonic combustion (in such engines the fuel combustion process occurs in a supersonic air flow)--Scramjet, which are also sometimes called hypersonic ramjet engines. The powerplant of the ASP must consist of several such engines (modules), and it is intended to use liquid hydrogen as the fuel and oxygen from atmospheric air as the oxidant.

The firms Boeing, General Dynamics, Lockheed, McDonnell Douglas, and Rockwell received the airframe contracts. They must initially present preliminary designs, after which two-three firms will be selected to continue the work.

As Western reviewers remark, the ASP should possess the following basic qualities: a high degree of integration of the airframe and the powerplant, heat-resistant construction calculated for repeated use, a long fuselage length with integral tanks for the cryogenic fuel, and a system to cool the nose section and the powerplant.

Most of the discussion centers on the type of powerplant, which should permit taking off, picking up speed, and flight at high hypersonic velocities and the transition to suborbital flight regimes. Some foreign specialists consider that after takeoff it is most effective to use the Scramjet for accelerating to speeds of M = 10--12 and a rocket motor for further acceleration of the ASP. Judging from the information in the foreign press, a combination engine of the ATR type (Air Turboramjet ramjet engine) of the Aerojet firm, an experimental model of which is undergoing ground tests, may be used for the purpose of takeoff and initial acceleration of the ASP.

From its very beginning research on the ASP has taken on a clearly military cast. A special body composed of representatives of the Air Force, Navy, and NASA with headquarters at Wright-Patterson AFB has been formed by the Pentagon to supervise the research. Moreover, some military experts in the USA are declaring a need to include this project in the American Star Wars (SDI) program.

As is clear from the information of the foreign press, the developers intend to use their offspring to perform the most diverse tasks. But in order to conceal the clear aggressive nature of the project from the man in the street, the story of the creation of a passenger liner version of the ASP is being presented.

8937
CSO: 1866/81

SATELLITE IMAGERY WITH 6-METER RESOLUTION OFFERED FOR SALE

Moscow IZVESTIYA in Russian 20 Jun 87 p 2

[Excerpt] Since the beginning of this year, the USSR Council of Ministers' Main Administration of Geodesy and Cartography (GUGK) has been authorized to carry on foreign economic relations independently. A foreign trade association "Soyuzkarta," which was created for this purpose has sent sample maps, atlases and other kinds of products, including photographs taken from space, to many countries.

"Considerable experience with photographing of the planet has been amassed in the USSR," said V. Yashchenko, the head of the administration. "Photographs obtained from 'Salyut' orbiting stations have been and still are being used extensively for peaceful purposes in various branches of the economy. Lately we have obtained photographs from orbit which I would say are of outstanding quality. They have a resolution of about 6 meters: in a small photograph taken from an altitude of approximately 300 kilometers, it is possible to distinguish objects that are 6 meters long and more. Until not long ago, only the Americans and the French were marketing this type of 'product' internationally."

"What is the quality of their photographs?"

"The resolution of the American photographs is not less than 30 meters. That is, in them one can distinguish objects that are 30 meters and bigger. For example, a motor vessel on a river. The resolution of the French photographs is not under 10 meters."

"Has anyone shown interest in buying our photographs from space?"

"There have been quite a few--one delegation after another. They have been surprised at the quality of the photographs. We have requests from Australia, Kuwait, Angola, the Korean People's Democratic Republic, Vietnam, the German Democratic Republic, and the Cape Verde Islands to make space photographs of their territories, for purposes of geology, agriculture, and evaluating water and forest resources."

FTD/SNAP
/8309
CSO: 1866/110

EQUIPMENT FOR 'KVANT' MODULE DEVELOPED AT FRUNZE SPECIAL DESIGN BUREAU

Frunze SOVETSKAYA KIRGIZIYA in Russian 13 May 87 p 2

[Article by E. Taranova]

[Abstract] The article gives an account of the development and testing of X-ray astronomy equipment for the space module "Kvant" which is part of the orbiting complex "Mir." This work was done by the Kirgiz Special Design Bureau of the USSR Academy of Sciences' Institute of Space Research. This bureau is located in Frunze.

It is recalled that the "Kvant" instrument development projects were expedited at the insistence of R. Syunyayev, corresponding member of the USSR Academy of Sciences and director of the experiment "Rentgen" (X-ray). The bureau was called upon to develop new-generation instruments which would far surpass their predecessors in accuracy, speed and storage capacity. A special development group with seven project leaders was created. Instruments called "Pulsar X-1," "Spektr-3" and "Burs" were developed under the direction of V. Shevchenko, Sergey Goncharov and R. Kanuper, respectively. S. Skochilo and D. Burgeyev were in charge of work on development of a filter unit and a power supply system, and V. Mamontov and S. Borovkova were responsible for development of control-and-measuring apparatus.

The "Pulsar-X-1" and "Spektr-3" are instrument sets consisting of narrow-directional sensors of X-radiation, and X-ray pulse analyzers. The "Burs" is intended for transmitting information from the X-ray instruments to the telemetry system of the module. The "Spektr-3" has a built-in microcomputer for processing of information which is said to be the first of its kind to be used in space. With the aid of this high-speed microprocessor, the working order of the instrument's units is checked, and malfunctioning ones are automatically disconnected and replaced with units in good working order.

FTD/SNAP
/8309
CSO: 1866/110

FRUNZE SPECIAL DESIGN BUREAU EXPERIENCING DIFFICULTIES WITH LOCAL AUTHORITIES

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 12 May 87 p 4

[Article by A. Barshay, correspondent (Frunze)]

[Excerpt] Workers of the Special Design Bureau of the USSR Academy of Sciences' Institute of Space Research are listening these days with particular interest to the reports from the orbiting scientific complex "Mir." The bureau, which is located in the city of Frunze, developed a number of instruments which are on the astrophysical module "Kvant."

In an interview which he gave to a TASS correspondent, academician R. Sagdeyev, director of the Space Research Institute, said that Frunze has become a recognized center of space instrument building. "The design bureau," he remarked, "possibly has more work in progress on development of instruments for space research than any other place. I am confident that the bureau in Frunze will do a worthy job on its newest assignment, which involves instruments for the multipurpose international [Mars] space project 'Phobos.' Nevertheless, I feel compelled to note that the bureau's staff at present is working in conditions which are far less than adequate for the task at hand: quarters are cramped, and there are a number of other problems. There is a serious need for help..."

It is sufficient to point out that each worker of the bureau has only one-third of the work space that he should have according to norms. Key sections such as the circuit-board and electroplating production facilities are located in dilapidated buildings that date from the 1930s and which were inherited from a rug factory. Conditions aren't much better for sections which must use such ultramodern technologies as laser optics and laser processing of materials, and microelectronics and vacuum technology.

The bureau's director, S. Tabaldyyev, said: "We are using the hectare and a half which was allotted for the creation of our bureau to the maximum extent. We have 'squeezed' practically all that we can out of this space."

Although it is understandable that the availability of property is a difficult problem in the city, nevertheless it seems there should be more expeditious action on the question of allotting a site for construction of new production facilities

for the bureau, which already has been agreed to in principle by all the authorities concerned. And this represents only the first step. Action is needed quickly also on questions of financing and preparation of plans and estimates.

The bureau has established a productive cooperation with the Kirgiz Scientific Research Institute of Cardiology, for which it has built several unique instruments. As a result of this cooperation, the republic's first engineering center for development of medical equipment was established not long ago. Together with the Kirgiz University, the bureau has created a chair of instruction for automated control system, which is based at the bureau. Also at its own initiative, the bureau is creating a city computer-technology educational complex for training school teachers, for teaching students about computers, and for advanced training of computer specialists.

The city, however, has plainly begun to take advantage of the public-mindedness of the bureau's staff. Its highly-skilled electronics assemblers and designers and engineers have been 'mobilized' for such chores as bricklaying and sorting harvested vegetables, street-cleaning and picking tomatoes. What purpose is served, for example, by the following order issued by the executive committee of the city's Sverdlovskiy District: "The design bureau's management is to assume personal responsibility for clearing brush and weeds in the sector of the Karagacheva Woods assigned to it!"

The space technology specialists are able, naturally, to lend a hand to builders and street crews, farm workers and policemen. But can tomato pickers or bricklayers come to the bureau's aid when there is a tight deadline to have unique instruments ready? It must be remembered that the design bureau has the word 'special' as part of its name, and its products go out into the orbits of space.

FTD/SNAP
/8309
CSO: 1866/110

DETAILS OF U.S.-SOVIET AGREEMENT ON SPACE COOPERATION

Moscow PRAVDA in Russian 18 Apr 87 p 5

[Article by B. Tikhonov]

[Excerpt] On 15 April 1987, E.A. Shevardnadze, USSR minister of foreign affairs, and G. Shultz, U.S. Secretary of State, signed an Agreement between the USSR and the USA on Cooperation in the Research and Use of Outer Space for Peaceful Purposes.

The new Soviet-American agreement points out that reasonable approaches to the problem of space are possible and realistic. In the preamble, the two sides emphasized that they wish results achieved in the course of peaceful research and use of outer space to be used for the good of the peoples of the two states and the whole world. The agreement calls for development of bilateral cooperation in the fields of research of the solar system, space astronomy and astrophysics, Earth science, physics of sun-Earth relationships, and space biology and medicine. Mixed working groups will be created for each of these directions. It is proposed to carry out joint measures within the framework of these groups. Sixteen specific cooperation projects are planned. Among them are studies aimed at determining the most promising places for landing on the planet Mars; exchange of scientific data for studying the surface of Venus, space dust, meteorites and lunar soil; coordination of work in line with the Soviet projects "Phobos" and "Vesta" and the American project "Mars--Observer"; exchange of research in the field of radio astronomy; coordination of work on studying global changes in the environment; cooperation in line with the program for biological satellites of the "Cosmos" series; and other measures.

Meetings of scientists and specialists will be held, delegations will be exchanged, and researchers and specialists of one side will take part in projects which the other is conducting. An understanding was reached that the list of specific projects may be extended as the agreement is implemented (its effective period is five years, with the possibility of extension), if the sides consider this mutually advantageous. The agreement calls also for the USSR and USA to further international cooperation in studying legal questions of mutual interest which may arise in connection with the study and use of outer space for peaceful purposes.

FTD/SNAP
/8309
CSO: 1866/110

USSR-GREAT BRITAIN AGREEMENT ON SPACE RESEARCH COOPERATION

Moscow IZVESTIYA in Russian 2 Apr 87 p 4

[Abstract] The article gives the text of a 10-year agreement between the governments of the USSR and Great Britain in regard to cooperation in the study, research and use of outer space for peaceful purposes. The agreement was concluded during the visit to the Soviet Union of a British delegation headed by Prime Minister M. Thatcher.

The agreement calls in particular for promoting space research cooperation in solar-Earth physics; planetology; high-energy astrophysics, including X-ray, far-ultraviolet, submillimetric and infrared astronomy; radio astronomy; materials science; space biology and medicine; and other fields to be agreed upon by the two countries. This cooperation may take such forms as exchanges of scientists and other specialists, and of experience and scientific information; joint research projects, including work on the designing, development and launching of spacecraft; and joint symposiums. Separate paragraphs contain provisions in regard to prompt sharing of information from joint experiments, financing of cooperation, and designation of performing organizations.

FTD/SNAP
/8309
CSO: 1866/110

SAGDEYEV INTERVIEWED ON PROSPECTS FOR INTERNATIONAL COOPERATION IN SPACE

Moscow PRAVDA in Russian 29 Jun 87 p 6

[Article by A. Lyutyy]

[Abstract] The article is an interview with academician R. Sagdeyev, director of the USSR Academy of Sciences' Institute of Space Research, regarding good possibilities that he sees for further international cooperation in the exploration and peaceful use of space despite the present world political situation. Sagdeyev cited numerous examples of successful joint space projects involving capitalist and socialist countries, which he said refutes U.S. retired Lieutenant General Daniel Graham's recently publicized contention that irreconcilable political differences between the USA and USSR exclude the possibility of effective peaceful cooperation in space. Among these examples, Sagdeyev mentioned that scientists of his institute are collaborating closely with the U.S. Jet Propulsion Laboratory, which a Soviet delegation visited recently to discuss prospects for exploration of the solar system. Sagdeyev noted that JPL's director, Lew Allen, is a former U.S. Air Force chief of staff.

FTD/SNAP
/8309
CSO: 1866/110

OBITUARY OF G.I. PETROV

Moscow IZVESTIYA in Russian 17 May 87 p 6

[Text] Soviet science has suffered a great loss. Academician Georgiy Ivanovich Petrov, an outstanding Soviet scientist in the fields of flight mechanics, gas dynamics and space research, died on 13 May 1987. He was a Hero of Socialist Labor and a USSR State Prize laureate.

G.I. Petrov was born in the city of Pinega, Arkhangelsk Oblast, in 1912. At the age of 16, he began his working career at the Ivanovo Weaving Mill. He graduated from Moscow University in 1935. While still a student, he began doing scientific work at the Central Aerohydrodynamics Institute.

G.I. Petrov's main works of this period were devoted to solving complex scientific and technical problems, which promoted the rapid advancement of aeronautical engineering. Georgiy Ivanovich Petrov established regularities involved in the interaction of shock waves with a boundary layer, which were of fundamental importance for solving problems of achieving supersonic speeds in aviation and space technology.

During the period of the Great Patriotic War, Georgiy Ivanovich performed a number of important studies which made it possible to improve the aerodynamic properties and combat characteristics of Soviet airplanes.

Beginning in 1944, G.I. Petrov directed major comprehensive research in the field of gas dynamics of hypersonic speeds. He became the founder of a school of gas-dynamics specialists who combined thorough theoretical analysis with bold experiments.

Together with academicians S.P. Korolev and M.V. Keldysh, G.I. Petrov was a pioneer of space research. Petrov and his associates successfully solved the problem of heat shielding of the first manned reentry vehicles.

In 1966, G.I. Petrov helped to organize and become the first director of the USSR Academy of Sciences' Institute of Space Research. His creative energy was directed at implementing a broad program of research involving study of near-Earth and interplanetary space, and of planets of the solar system with the aid of unmanned and manned spacecraft.

G.I. Petrov devoted much energy and effort to teaching at Moscow University, where he became head of the chair of flight mechanics and gas dynamics in 1955.

G.I. Petrov was elected a corresponding member of the USSR Academy of Sciences in 1953, and a full member of the academy in 1958.

G.I. Petrov contributed substantially to solving ecological problems. He did much work on expert scientific examination of plans for diverting a portion of the flow of northern rivers, which contributed to the adoption of an important government decision.

The Soviet state appreciated G.I. Petrov's scientific, educational and public work highly. The title of Hero of Socialist Labor was conferred upon him, and he was awarded four orders of Lenin, three orders of the Red Banner of Labor, and medals. The USSR State Prize was awarded to him twice.

The fond memory of Georgiy Ivanovich Petrov, a loyal son of the Motherland, will remain forever in the hearts of Soviet people.

(The obituary is submitted by the presidium of the USSR Academy of Sciences; the academy's departments of problems of machine building, mechanics and control processes, and of general physics and astronomy; the academy's Institute of Problems of Mechanics and Institute of Space Research; the USSR Ministry of Higher and Specialized Secondary Education; the Moscow State University; and the Central Aerohydrodynamics Institute imeni Zhukovskiy.)

FTD/SNAP
/8309
CSO: 1866/110

'SPEKTR-RENTGEN-GAMMA' PROJECT PLANNED FOR EARLY 1990S

Moscow MOSKOVSKAYA PRAVDA in Russian 10 Jun 87 p 3

[Article by V. Ovcharov, correspondent]

[Text] A unique international project in the field of extra-atmospheric X-ray and gamma astronomy, which is planned for the early 1990s, will be carried out with the aid of Soviet spacecraft of a new generation. Participants of a conference which opened at the USSR Academy of Sciences' Institute of Space Research on 9 June are discussing this project. Among them are leading scientists of the USSR and other countries which belong to the "Intercosmos" program, and also of Great Britain, Denmark, Italy, the Netherlands, the United States, France, the Federal Republic of Germany, Japan, and the European Space Agency.

The new project is called "Spektr-Rentgen-Gamma." The first satellite of the "Spektr" series for planetary and astrophysical observations will carry two and a half tons of apparatus into an orbit with a high apogee in 1991-1992. An orbiting unmanned observatory of the type of the "Kvant" module will subsequently take over these observations from the satellite.

FTD/SNAP
/8309
CSO: 1866/110

LIST OF RECENT SOVIET SPACE LAUNCHES

Moscow TASS in English or Russian various dates

[Summary]

Date	Designation	Orbital Parameters			
		Apogee	Perigee	Period	Inclination
15 May 87	Energiya	(First flight test of new heavy-lift launch vehicle; 100-ton payload capacity; satellite mockup failed to achieve orbit)			
19 May 87	Progress-30	265 km	192 km	88.8 min	51.6°
		(To deliver expendables to "Mir" station)			
21 May 87	Cosmos-1846	314 km	196 km	89.2 min	82.4°
		(To continue study of Earth's natural resources in interests of Soviet economy & international cooperation; data received by State Scientific Research and Production Center "Priroda" for processing and use)			
26 May 87	Cosmos-1847	373 km	177 km	89.7 min	67.2°
28 May 87	Cosmos-1848	400 km	208 km	90.2 min	72.9°
4 Jun 87	Cosmos-1849	39,342 km	613 km	11 hrs 49 min	62.9°
9 Jun 87	Cosmos-1850	825 km	785 km	100.8 min	74°
12 Jun 87	Cosmos-1851	39,402 km	592 km	11 hrs 50 min	62.8°
16 Jun 87	Cosmos-1852 -- Cosmos-1859	1,507 km	1,440 km	115 min	74°
		(Eight satellites orbited by single launcher)			
19 Jun 87	Cosmos-1860	283 km	255 km	89.7 min	65°

Date	Designation	Orbital Parameters			
		Apogee	Perigee	Period	Inclinatio
23 Jun 87	Cosmos-1861	1,014 km	995 km	105 min	83°
		(To operate in the space navigation system for determining position of ships of USSR maritime & fishing fleets; also carries equipment for amateur radio links and experiments)			
1 Jul 87	Cosmos-1862	679 km	645 km	97.7 min	82.5°
4 Jul 87	Cosmos-1863	383 km	208 km	90.8 min	72.9°
7 Jul 87	Cosmos-1864	1,019 km	977 km	104.8 min	83°
8 Jul 87	Cosmos-1865	327 km	204 km	89.5 min	64.8°
9 Jul 87	Cosmos-1866	386 km	177 km	89.8 min	67°
10 Jul 87	Cosmos-1867	813 km	797 km	100.8 min	65°
14 Jul 87	Cosmos-1868	726 km	279 km	94.5 min	74°
16 Jul 87	Cosmos-1869	679 km	647 km	97.8 min	82.5°
		(To obtain oceanographic data; carries scanning opticomechanical and radiophysical apparatus; data received at the State Scientific Research Center for Study of Natural Resources and at autonomous data reception stations of the State Committee for Hydrometeorology & Environmental Control)			

CSO: 1866/109

END

10

Foreign Broadcast Information Service (FBIS) and Joint Publications Research Service (JPRS) publications contain political, economic, military, and sociological news, commentary, and other information, as well as scientific and technical data and reports. All information has been obtained from foreign radio and television broadcasts, news agency transmissions, newspapers, books, and periodicals. Items generally are processed from the first or best available source; it should not be inferred that they have been disseminated only in the medium, in the language, or to the area indicated. Items from foreign language sources are translated. Those from English-language sources are transcribed, with the original phrasing and other characteristics retained.

Headlines, editorial reports, and material enclosed in brackets [ ] are supplied by FBIS/JPRS. Processing indicators such as [Text] or [Excerpts] in the first line of each item indicate how the information was processed from the original. Unfamiliar names which are rendered phonetically or transliterated by FBIS/JPRS are enclosed in parentheses. Words or names preceded by a question mark and enclosed in parentheses were not clear from the original source but have been supplied as appropriate to the context. Other unattributed parenthetical notes within the body of an item originate with the source. Times within items are as given by the source.

SUBSCRIPTION/PROCUREMENT INFORMATION

The FBIS DAILY REPORT contains current news and information and is published Monday through Friday in 8 volumes: China, East Europe, Soviet Union, East Asia, Near East & South Asia, Africa (Sub-Sahara), Latin America, and West Europe. Supplements to the DAILY REPORTs may also be available periodically and will be distributed to regular DAILY REPORT subscribers. JPRS publications generally contain less time-sensitive information and are published periodically. Current JPRS publications are listed in *Government Reports Announcements* issued semi-monthly by the National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, Virginia 22161 and the *Monthly Catalog of U.S. Government Publications* issued by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

U.S. Government offices may obtain subscriptions to the DAILY REPORTs or JPRS publications (hardcovers or microfiche) at no charge through their sponsoring organizations. DOD consumers are required to submit requests through appropriate command validation channels to DIA, RTS-2C, Washington, D.C. 20301. (Telephone: (202) 373-3771, Autovon: 243-3771.) For additional information or assistance, call FBIS, (703) 527-2368, or write to P.O. Box 2604, Washington, D.C. 20013.

The public may subscribe to either hardcover or microfiche versions of the DAILY REPORTs and JPRS publications through NTIS at the above address or by calling (703) 487-4630. Subscription rates will be provided by NTIS upon request. Subscriptions are available outside the United States from NTIS or appointed foreign dealers. Back issues or single copies of the DAILY REPORTs and JPRS publications are not available. New subscribers should expect a 30-day delay in receipt of the first issue.

Both the DAILY REPORTs and the JPRS publications are on file for public reference at the Library of Congress and at many Federal Depository Libraries. Reference copies may also be seen at many public and university libraries throughout the United States.